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PROPOSAL FOR A SYSTEM OF BIOLOGICAL NOMENCLATURE, WITH SPECIAL REFERENCE TO MICROORGANISMS [1]

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An absolute system of nomenclature, in which all of the characters employed for the identification of the organism are directly discernible from the name itself, is proposed.

Particularly in microbiology the use of the present system, as described by Briquet (1935), meets with many difficulties. There are the recurrent arguments over the concept of "major" and "minor" characters in delimiting the "species," the grouping and regrouping maneuvers of the "lumpers" and the "splitters," the persistence of *nomina nuda*, the multiplicity of synonyms and homonyms, the lack of fixity of names in taxonomic areas which have not been monographed and the continuous infusion of erroneous identifications into the literature. The question was entertained by Siu (1951) whether it is feasible to borrow some of the features of the simpler and more stable system of chemical nomenclature; or to modify certain numerical keys, such as those used by Davidson *et al.* (1942) and Nobles (1948) for the wood-rotting fungi into pronounceable words; and to formulate a more functional system of biological nomenclature.

In this paper, the principle of the suggested system is given with several examples in the *Fungi Imperfecti*. This will suffice as the basis for an evaluation of the *idea*. The final expression of the method will require intensive work by experienced and skilled taxonomists.

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GENERAL RULES FOR PROPOSED SYSTEM OF NOMENCLATURE

The name of the organism shall consist of two words, each of which contains nine letters, comprising three syllables. The succession of letters in each word shall be

CVCCVCCVC

where C represents a consonant and V a vowel. This arrangement provides a pronounceable series of letters.

Each letter shall represent one or a group of observable taxonomic characters. Since there are twenty-one consonants and five vowels, each character can be divided into twenty-one or into five divisions depending upon the position the representative letter occupies in the name. If there is doubt concerning the accuracy of determination of the character in question or if the available specimen does not allow for a study of that character, the consonant "X" or the vowel "O" shall be used. Upon acquisition of the requisite data, these tentative letters shall be replaced by the final ones.

If more or less than the 18 characters stipulated above are required, the individual words may be lengthened or shortened by employing the same pronounceable succession of letters. If deemed necessary, a trinomial may be invoked. As a final resort even numbers may be used between words, in which case each numbered position is capable of 10 subdivisions, with zero representing a doubtful character. The need for these modifications can be determined only after an intensive study of the proposed system.

It is suggested that the more readily observable characters or those separating the larger phylogenetic groups be represented among the first letters. Those characters observable with the greatest difficulties, those of a more mutable nature, and those of occasional appearance should be relegated toward the terminal positions in the name.

In the case of a binomial system it would be desirable to arrange the succession of characters, such that the first word generally indicates what is currently considered the genus and the second, the species.

ILLUSTRATIVE EXAMPLES

It is believed that the proposed system can be applied to all organisms. The theoretical number of different names using 18 letters (12 of which are consonants and 6 vowels) is $20^{12} \times 4^6$ or 17,000,000,000,000,000,000. To illustrate the applicability of the system, five examples in the *Fungi Imperfecti* are given below. In this instance, the keys to the genera according to Clements and Shear (1931) are used. It is to be noted from the resulting characters (Table 1) that the first letter is used to separate fungi from other organisms. The second letter then divides the fungi into four large groups of which the *Fungi Imperfecti* is one. The examples have been developed with the thought that it will probably be necessary

to develop new sets of characters for each of the four major groups of fungi, i.e. beginning with the third letter in the name.

The following five examples show how genera in the *Fungi Imperfecti* would be coded according to the information from Table 1.

Present Name:	Illustrative New Name:
Aspergillus	**Fimmabbat**
Gliocladium	**Fimmapbam**
Penicillium	**Fimmapbat**
Oedocephalum	**Fimmebbat**
Stilbum	**Fismenbat**

Thus *Penicillium* and *Oedocephalum* differ by only one character from *Aspergillus* while *Stilbum* differs in three characters. *Gliocladium* differs from *Penicillium* in one character. How closely related two genera are phylogenetically would be indicated by how far from the end of the coded word they differ in a particular character, thus the third letter represents divergence in families, *Stilbum* being in a different family than the other three genera.

As a further example, a *nomen nudum* may be considered. Accordingly, Weston's *Aglaiocephalum* (Weston, 1933) would assume the name, *Fimmetbak*.

ADVANTAGES AND DISADVANTAGES OF PROPOSED SYSTEM

Two centuries of work have been based on the present binomial system. To suggest that this system be replaced by another requires a serious consideration of the resulting advantages and disadvantages. The difficulties inherent in the current system have been mentioned in the introductory paragraphs of this paper. The more significant advantages of the proposed system of nomenclature are:

1. Informative nature of names:

   The proposed name immediately provides the reader with a large amount of morphological and physiological information about the organisms. Phylogenetic relationships would also be readily apparent from the name. Thus, the degree of relationship would be indicated by how far from the first letter of the coded name a difference between the two names exists.

2. Fixity of names:

   Present rules permit many occasions for changes of names. It is not uncommon to find a dozen synonyms for the same organism. There is the question of historical priorities, for example. In the proposed scheme, once an organism is described, the name is not subject to change.

3. Clarity of tentative names:

   In the prevailing system, there is no way to know how "tentative"

a tentative identification is. In the proposed system, the use of the letters "X" and "O" clearly identifies those characters in which doubt exists. The proposed system minimizes the tendency of some investigators to force a culture into a known species even though doubt exists as to the fitness of several characters.

4. *Nomina nuda*:

Frequently names of organisms are mentioned in papers without accompanying descriptions. Since it is not possible to tell anything about the morphology and physiology from the name, these *nomina nuda* are of use only when they are later fortified with the proper descriptions. In many cases, the latter are not forthcoming and the meaningless names remain in the literature. If the proposed system of nomenclature is accepted, *nomina nuda* will be eliminated, for the mere presentation of the name itself provides considerable information about the organism. This has been exemplified earlier in this paper using Weston's *Aglaiocephalum*.

5. Objectivity:

Subjectivity is reduced to a minimum in the proposed system. For example, the question of relative importance of characters does not come into play in the proposed system nearly as much as it does in the present system. This eliminates the perennial argument between the "lumper" and the "splitter" as to whether a given difference in character is of sufficient magnitude to create, say, a new "species." According to the proposed system, the difference is merely taken care of by the appropriate letter, without need of changing the entire name of the organism.

6. Functional simplicity:

With its simple rules and freedom from historical priorities, the proposed system is much easier to follow than the present system particularly for the naming of new organisms. It is well within the grasp of the non-taxonomist, when the more typical organisms are concerned. Even the professional taxonomist is spared considerable time and effort by not being required to delve into the past literature with such intensity as required by the present system to make sure that the organism had not been previously named.

7. Reduction in number of synonyms, homonyms, and misidentifications:

Given a correct observation of the characters in the laboratory, two independent workers will arrive at exactly the same name using the proposed method. This is not true with the present system. As discussed in "5" above, one individual may decide to coin a new name for the organism while the other investigator may decide to use the closest available name.

8. Flexibility for special purposes:

(a) Names of organisms following the proposed system are readily adaptable to the IBM or punched card method of studying the correlation of characters. This opens up new scientific and industrial possibilities for the taxonomic researcher.

(b) Individual, scientific or industrial groups interested in minor, specialized traits such as strain differences and genetic mutations may, for their own purposes, expand the prevailing name to include special characters. Such characters are not part of the accepted name, of course, but correspond more to the presently used strain numbers or varieties. If in the future, some of these traits do, in fact, represent important taxonomic features, they can be readily added to the prevailing name, without vitiating the earlier results.

(c) Ease of handling herbarium specimens and filing library references is another advantage of the proposed system. The present scheme demands a knowledge of taxonomy on the part of a herbarium attendant and clerk, for frequently the organisms are filed according to families or phylogenetic groups. With the proposed system, ordinary alphabetical arrangement suffices.

As far as the authors can see, the proposed system is beset with no serious taxonomic difficulties, other than those inherent in any taxonomic endeavor. In this respect, it excels the present method. However, there are two disadvantages in the proposed scheme which must be considered. One is the seriousness of typographical errors. A mistake in a single letter may throw an organism into an entirely different class. The other is the difficulty in verbal presentation.

These disadvantages can be minimized by a careful choice of letters during the development of the basic keys, so that the more common species will have the more euphonious names. For this reason, the collaboration of phoneticists is clearly indicated. Furthermore, since not all of the letters possible for a given position will be used in the name, attention can be directed to the selection of letters which are as different as possible from each other in sound and appearance. It is believed that the difficulties of verbal presentation can be reduced to an acceptable level by such means. The seriousness of typographical errors, though decreased considerably, still remains and diligent proof-reading will be necessary. Actually this may not work out in practice to be as great as it may first appear, for usually the rest of the context will aid in the recognition of such errors. While one is tempted to prejudge the magnitude of such a source of error, probably it can be determined with accuracy only after the system has been developed and put into use for some time.

It may also be desirable that during the transition period, the present names are retained, followed by the proposed name in parenthesis. The use of dual names may be carried on until such a time that acquaintance with the new system becomes general.

SUMMARY

An absolute system of biological nomenclature has been proposed as a replacement for the present one. In the new system, all of the characters that enter into the final identification of the organism are directly discernible from the name itself. It is hoped that this proposal will stimulate a healthy reexamination of the system of nomenclature used heretofore, and of the various means which can be employed to minimize its inherent difficulties. The proposal in this paper is humbly presented as one approach to the problem.

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TABLE 1. ILLUSTRATIVE KEY FOR LETTERS OF THE FIRST NAME ACCORDING TO PROPOSED SYSTEM OF NOMENCLATURE.

Position of letter	Description of Character		Letter
First			
	Plant phyla		
	Spermatophyta	Gymnosperms	G
		Angiosperms	H
	Pteridophyta	Ferns & allies	D
	Bryophyta	Mosses, etc.	M
	Thallophyta		
	with chlorophyll	Algae	C
	without chlorophyll		
	Filamentous	Fungi	F
	Nonfilamentous	Bacteria	B
	Fungi parasitic on Algae	Lichens	L
	Myxomycetes		K
	Animal Phyla		
	Protozoa		P

Position of letter	Description of Character		Letter
Second			
	Fungi		
	Possessing a known sexual stage		
	Mycelium coenocytic; sexual spores borne within a sporangium.	Phycomycetes	E
	Mycelium septate		
	Sexual spores, borne in a sac, usually 8 spores per ascus.	Ascomycetes	A
	Sexual spores borne externally on a basidium, usually 4 spores per basidium.	Basidiomycetes	U
	Possessing no known sexual stage, or if known, then rare or infrequent	Fungi Imperfecti	I
Third			
	Conidia borne in pycnidia		
	Pycnidia globoid, ostiolate or astomous		
	Pycnidia brown to black, membranous to carbonaceous	Phomaceae	P
	Pycnidia bright colored; fleshy, gelatinous or waxy	Zythiaceae	Z
	Pycnidia dimidiate, more or less radiate or hysterioid.	Leptostromaceae	L
	Pycnidia apothecium-like or hysterioid, opening circularly or by a cleft or lobes	Discellaceae	B
	Conidia not borne in pycnidia		
	Conidiophores borne on a more or less parenchymoid stroma	Melanconiaceae	G
	Conidiophores not on a stroma		
	Hyphae in cottony masses		
	Hyphae and spores hyaline or bright colored	Moniliaceae	M
	Hyphae and/or spores typically dark	Dematiaceae	D
	Hyphae compacted to form spore-body		
	Spore-body sessile, globose to applanate (sporodochium)	Tuberculariaceae	T
	Spore-body stalked, capitate to cylindric (synnema)	Stilbaceae	S
	Conidia absent	Sterile Mycelia	K
Fourth			
	Conidia one-celled	(Amerosporae)	
		Mucedineae	M
		Dematieae	N
	Conidia two-celled	(Didymosporae)	
		Mucedineae	T
		Dematieae	G
	Conidia 3-many celled, septa transverse	(Phragmosporae)	
		Mucedineae	B
		Dematieae	C

Position of letter	Description of Character		Letter
	Conidia 3-many celled, septa transverse & longitudinal	(Dictyosporae)	
		Mucedineae	P
		Dematieae	K
	Conidia filiform	(Scolecosporae)	
		Mucedineae	S
		Dematieae	L
	Conidia spirally twisted	(Helicosporae)	
		Mucedineae	D
		Dematieae	F
	Conidia forked, radiate or united	(Staurosporae)	
		Mucedineae	R
		Dematieae	V
Fifth			
	Hyphae very short or little different from the conidia		
	Spores catenate		I
	Spores not catenate		U
	Hyphae elongate & distinct from conidia		
	Spores catenate		A
	Spores not catenate		E
Sixth			
	Conidia exogenous		
	Conidiophore simple, unbranched:		
	Spores terminal		G
	Spores typically pleurogenous		L
	Conidiophore simple, branched:		
	Branching irregular; spores terminal		T
	Branching irregular; spores pleurogenous		D
	Branching verticillate; spores terminal		V
	Branching penicillate; spores terminal		P
	Conidiophore inflated:		
	Terminal swelling		B
	Joints inflated		J
	Conidiophore compound:		
	Spore bearing portion simple, globose		M
	Spore bearing portion simple, cylindric		N
	Spore bearing portion branched		S
	Conidia endogenous		F
Seventh			
	Conidia globose to subglobose		
	Smooth to somewhat rough		B
	Very rough i.e. tuberculate, spiny, stellate		D
	Conidia allantoid		K
	Conidia elliptic to cylindric		
	Smooth		G
	Rough		R

Position of letter	Description of Character	Letter
	Conidia fusoid	
	Smooth	M
	Rough	N
	Conidia ciliate	P
Eighth		
	Parasitic on plants	E
	Parasitic on animals	I
	Saprophytic	A
	Some forms parasitic, some saprophytic	U
Ninth		
	(Miscl. hodge-podge to catch various genera)	
	Spores held together by mucilaginous substance	M
	Sterile structures in spore bearing mass, spines, etc.	K
	Stroma present	L
	Subiculum present	S
	None of above	T

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ACTIVITY OF FUNGI ON OILS

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Plastic films, like other substances composed of organic materials, are subject to the degradative action of microorganisms. Under favorable conditions of moisture and temperature, microorganisms attack certain types of plasticizers although the plastic itself does not appear to be affected. Since the plasticizer is added to make the films flexible, microbial action results in a stiffening of the film (Harvey, 1949). Plasticizers vary in resistance from inert compounds such as tri-octyl-phosphate to extremely susceptible ones such as castor oil. For reasons of availability, cost or requirements of specific properties, it is frequently necessary to use plasticizers which are non-resistant. A study has been made in these laboratories of the breakdown of several homologous series of esters by the fungus *Aspergillus versicolor* and by the bacterium *Pseudomonas aeruginosa* (Stahl and Pessen, 1953). Results of tests conducted under the auspices of the National Defense Research Committee during World War II are summarized by Brown (1946). Most plasticizers are of the ester type. Those composed of naturally occurring oils and fatty acids (i.e. laurates, stearates, ricinoleates, etc.) are known to support microbial growth, while synthetic plasticizers of the phthalate and phosphate types are generally resistant. The present study was undertaken to determine the range of organisms capable of growing on typical plasticizers. It supplements a previous publication covering the activity of the same fungi on cotton and on wool (Reese, et al, 1950). The activities of some (358) of these organisms on coconut oil, methyl-acetyl-ricinoleate (or di-hexyl-sebacate) are being reported here.

Comparatively little information on fat utilization by fungi is available. Much more interest has been shown in fat *synthesis*. On the other hand degradative action by bacteria has been more fully covered. One of the best reviews is the 26 page chapter "Action of Microorganisms on Fat" by Jensen in his recent book (1945). Fats decompose slowly in the soil (Waksman, 1932). Fungi and aerobic bacteria are largely responsible. A comparative study of bacterial action on lipids (Castell and Garrard, 1941) showed *Pseudomonas aeruginosa*, *Alcaligenes viscosus*, and *Staphylococcus aureus* as possessing distinct lipolytic action. The factors affecting lipase production by two of these bacteria, *Alcaligenes viscosus* and *Pseudomonas aeruginosa,* were recently investigated (Cutchins, Doetsch, Pelczar, 1951). In the Actinomycetes, several of the antibiotic producing species of Streptomyces have been found to utilize animal and

vegetable oils. Replacement of all of the carbohydrate by lipids did not decrease the yields of antibiotic produced (Perlman and Wagman, 1952). Fungi, especially Aspergilli and Penicillia, have frequently been observed growing on margarine and butter. Undoubtedly many of those fungi found on paints, meats and other complex substrata are obtaining their nutrient from the *fatty* constituents therein.

We are not concerned here with the mechanism of breakdown of the compounds under consideration. Indeed, the manner of attack does not appear to have been clearly established for various types of esters. Probably the action revolves around hydrolytic breakdown — lipases attacking glycerides such as coconut oil; esterases breaking down the simple esters. This aspect of the enzymic hydrolysis of fats and esters has been reviewed recently by Ammon and Jaarma (1950).

METHODS

Cultures were set up in triplicate in 250 ml Erlenmeyer flasks containing 0.5g of coconut oil ("Moonstar," Procter and Gamble), di-hexyl sebacate (Hardesty Chemical Company) or methyl acetyl ricinoleate (P4, Baker Castor Oil Company) and 50 ml of nutrient solution (1.0 g NH_4NO_3; 1.36 g KH_2PO_4; 0.2 g $MgSO_47H_2O$; 0.1 g Difco yeast extract; 1000 ml distilled H_2O; pH adjusted to 6.4). The di-hexyl sebacate was purified by adsorption on activated silica, activated alumina and Fuller's earth. After autoclaving, the media were inoculated with a spore suspension, and placed on a reciprocal shaker at 30°C for 7 days. Dry weights of the mycelium produced were determined after filtering on sintered glass crucibles, extracting the residual oil with an excess of absolute ethanol and drying at 70°C. Results are based on the average dry weight of mycelium per flask.

RESULTS

Results are presented in detail in the appendix. The data are summarized in Table 1 in which 5 categories of growth have been set up. The percentage of the strains falling into each category is shown as well as the total number of strains tested. Sebacate was distinctly inferior as a substratum. Over

TABLE 1. GROWTH OF FUNGI ON FATTY MATERIALS

Growth			% of Strains Tested		
Category	Wt/flask	as % wt. of oil	Coconut Oil	Ricinoleate	Sebacate
0	0–10 mg	0–2%	5%	10%	40%
1	11–100	3–20	39	57	58
2	101–200	21–40	31	29	1
3	201–300	41–60	22	4	0
4	301+	60+	3	0	0
Number of strains tested			358	309	82

95% of all strains tested showed less than 50 mg growth/flask (i.e. less than 10% conversion of oil to mycelium). No effort was made to determine the cause. The other ester, ricinoleate, was a fairly good substratum for 90% of the test organisms. The glyceride, coconut oil, was by far the best substratum of those tested in that 95% of the organisms were able to grow on it, and the per cent conversion of substratum to fungus tissue was greatest. While a few cases have been found where the amount of growth on ricinoleate exceeded that on coconut oil, the reverse is usually true.

The organisms falling at either extreme, i.e., no growth (group 0) or very good growth (groups 3,4) are listed in Tables 2 and 3. Much of the screening done has been on Aspergilli. The results indicate that members of the following groups are usually very active: *A. terreus*, *A. niger* (the *A.*

TABLE 2. ORGANISMS GROWING LITTLE OR NOT AT ALL UNDER CONDITIONS OF THE TEST (GROUP 0) †

Acrostalagmus cinnabarinus	QM	320e	Colletotrichum sp.	QM	533
Amblyosporium botrytis	QM	971	Ctenomyces serratus	QM	256
Aspergillus repens	QM	44c	Phialophora lagerbergii	QM	267
Basidiomycete (conidial stage)	QM	592	Pholiota adiposa	QM	512
" " "	QM	870	Polyporus sulfureus	QM	509
Botryosporium pulchrum	QM	965	Sepedonium sp.	QM	913
Botryotrichum piluliferum	QM	991	Stereum purpureum	QM	1014

TABLE 3. ORGANISMS GROWING BEST ON OILS (GROUPS 3, 4) †

Alternaria tenuis	QM	73b	Beauveria bassiana	QM	972
Aspergillus carbonarius	QM	331	Brachysporium sp.	QM	70g
A. clavatus	QM	872	Chaetomium globosum	QM	38f
A. fischeri	QM	865	* Ch. spirale	QM	622
A. flavus	QM	63c	Circinella sydowi	QM	629
A. niger	QM	458	* Cunninghamella bertholletiae	QM	1021
A. niger mut. cinnamoneus	QM	326	* C. blakesleeana	QM	631
A. niger mut. schiemanni	QM	327	* C. echinulata	QM	154f
A. ochraceus	QM	880	Paecilomyces varioti	QM	823
A. oryzae	QM	82i	Penicillium citrinum	QM	1a
A. parasiticus	QM	884	Pestalotia royenae	QM	531
A. phoenicis	QM	1005	Pestalotia virgatula	QM	479
A. sydowi	QM	31c	* Phomaceae	QM	13e
A. tamarii	QM	75b	* Phomaceae	QM	699
* A. terreus	QM	72f	Phomaceae	QM	618
* A. ustus	QM	891	Phomaceae	QM	703
A. ustus var. laevis	QM	893	Phomaceae	QM	576
A. versicolor	QM	432	Rhizopus sp.	QM	1032
A. violaceo-fuscus	QM	335	* Septonema sp.	QM	818

* The asterisk indicates those organisms whose mycelial weight exceeded 60% of the initial weight of the coconut oil.

† See Table 1.

luchuensis series is only moderately active), *A. flavus-oryzae*, *A. fumigatus*, *A. clavatus*, *A. tamarii*, *A. versicolor*, *A. ustus*. Moderate activity is shown by *A. nidulans* group. Least activity is shown by members of the *A. repens*, and *A. wentii* groups. In the genus Chaetomium, as in the Aspergilli, the isolates of each species are quite uniform in activity. The relative activities of the several species are:

Very active: *Ch. globosum*, *Ch. spirale*, *Ch. mollipilium*

Moderate activity: *Ch. elatum*, *Ch. funicolum*, *Ch. cupreum*, *Ch. atrobrunneum*, *Ch. indicum*, *Ch. tortile*, *Ch. cochliodes*

Weakly active: *Ch. causiaeformis*, *Ch. velutinum*

Cladosporium herbarum isolates had medium to low activity on the oils used. This is odd since the isolates included two from sheepskin which Weston (1951) found to grow well on both animal and plant oils. *Cladosporium herbarum* and *Pullularia pullulans* are frequent causes of spotting of paints, yet neither fungus compares in activity with many others here tested on oils. This would indicate the difficulty of translating information obtained in shake flasks to other environmental conditions. Activity on the oils of paint, or of animal carcasses, evidently hinges on other factors.

Insect parasites appear to be very active consumers of oils. Thus, we find *Beauveria bassiana*, *Aspergillus parasiticus*, and *Aspergillus flavus*, in the very active group, but the common plant parasite *Botrytis cinerea*, on the other hand, has very little fat degrading ability. This observation is based on very few cases, and no generalization is intended.

The Phycomycetes vary in ability to metabolize oils. Best of the Phycomycetes tested are three species of Cunninghamella, *C. bertholletiae*, *C. blakesleeana*, *C. echinulata*. All three showed a mycelial weight equal to 65% of the initial weight of coconut oil, and to 20–40% of the initial ricinoleate. *Rhizopus spp.*, and *Circinella sydowi* are also very active, while *Absidia capillata* is rather weak. Of the Basidiomycetes tested, most appear to be relatively inactive, though this may be largely the result of the use of slow-growing vegetative inoculum. *Polyporus versicolor* had moderate activity on coconut oil.

SUMMARY

Of the fungus isolates in the Quartermaster Culture Collection tested for their ability to grow on fatty materials: 95 percent grew on coconut oil, 90 percent on methyl acetyl ricinoleate and 60 percent on di-hexyl sebacate. Ability of fungi to hydrolyze extracellularly the ester linkage appears to be extremely widespread.

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APPENDIX

Organism	QM Number	Relative Activity * on Coconut Oil	Ricinoleate
Absidia capillata van Tieghem	8b	1	1
Absidia sp.	579	2	
Acremonium sp.	1b	1	
"	89c	1	1
"	581	1	
"	582	1	1
"	583	1	
Acrostalagmus cinnabarinus Corda	320e	0	0
Aegerita sp.	566	2	
Alternaria oleracea Milbrath	280	1	1
Alternaria solani (Ellis and Martin) Sorauer	281	1	
Alternaria tenuis Nees	26a	2	2
"	73b	3	
"	85i	1	1
"	120m	2	
"	584	2	1
"	585	1	
"	586	2	2
Alternaria sp.	15a	2	
"	298	2	
"	587	2	

* See table 1.

Organism	QM Number	Relative Activity on Coconut Oil	Ricinoleate
Amblyosporium botrytis Fresenius	971	1	
Arthrobotrys arthrobotryoides (Berlese) Lindau	669	1	
"	1024	1	
"	1025	1	
Arthrobotrys superba Corda	670	1	
Arthrobotrys superba Corda var. **oligospora** Coemans	671	1	
Aspergillus caespitosus Raper and Thom	961	1	2
Aspergillus carbonarius (Bainier) Thom	331	3	1
Aspergillus chevalieri (Mangin) Thom and Church	52b	1	0
"	64c	1	
"	112a	1	
"	312	1	
Aspergillus chevalieri (Mangin) var. **intermedius** Thom and Raper	58b	1	0
"	914	1	
Aspergillus clavatus Desmazieres	862	1	1
"	872	3	1
"	863	2	
Aspergillus echinulatus (Delacr.) Thom and Church	962	1	1
Aspergillus fischeri Wehmer	864	3	2
"	865	3	
"	866	2	2
"	867	2	
Aspergillus flavipes (Bainier and Sartory) Thom and Church	24a	1	1
"	868	1	1
"	869	1	
Aspergillus flavus Link	4m	2	2
"	10e	3	
"	63c	3	3
"	70a	3	
"	138f	3	
"	380	2	
"	870	2	
Aspergillus flavus-oryzae series	871	3	2
Aspergillus foetidus Thom and Raper	328	2	1
Aspergillus fonsecaeus Thom and Raper	330	3	1
Aspergillus fumigatus Fresenius	6b	2	2
"	45h	2	1
"	445	2	
"	497	2	
Aspergillus giganteus Wehmer	620	2	2
Aspergillus luchuensis series	102d	1	1
"	155e	2	
"	873	2	
"	874	2	
"	21e		1

Organism	QM Number	Relative Activity on Coconut Oil	Relative Activity on Ricinoleate
Aspergillus montevidensis Talice and MacKinnon	401	1	1
Aspergillus nidulans (Eidam) Winter	25b	2	2
"	87c	2	1
"	875	1	
"	876	1	
Aspergillus niger van Tieghem	458	3	2
"	877	3	1
"	878	3	
Aspergillus niger mut. **cinnamomeus** (Schiemann) Thom and Raper	326	3	2
Aspergillus niger mut. **schiemanni** (Thom) Thom and Raper	327	3	3
Aspergillus niger series	4j	3	
"	38b	3	
"	45d	3	
"	50c	2	
"	154a	3	
"	198b	3	
"	386	4	
"	861	3	2
Aspergillus niveus Blochwitz	879	2	2
Aspergillus ochraceus Wilhelm	26b	3	1
"	58c	2	1
"	880	3	2
Aspergillus oryzae (Ahlburg) Cohn	22b	3	2
"	82i	3	2
Aspergillus panamensis Raper and Thom	882	3	1
Aspergillus parasiticus Speare	883	3	3
"	884	3	3
Aspergillus phoenicis (Corda) Thom and Currie	329	3	2
"	1005	3	2
Aspergillus repens (Corda) deBary	44c	0	0
"	56f	1	0
"	59g	1	1
"	210	1	0
"	360	1	0
"	361	1	0
"	364	0	0
"	564	3	2
Aspergillus restrictus G. Smith	885	2	0
Aspergillus rugulosus Thom and Raper	886	1	1
Aspergillus sclerotiorum Huber	661	2	2
Aspergillus sydowi (Bainier and Sartory) Thom and Church	4d	1	1
"	31c	3	1
"	41a	3	1
"	54a	1	1
"	96a	3	1
"	103g	3	1

Organism	QM Number	Relative Activity on Coconut Oil	Relative Activity on Ricinoleate
Aspergillus tamarii Kita	50b	3	2
"	75b	3	2
"	887	3	2
"	888	3	2
Aspergillus terreus Thom	72f	4	2
"	82j	3	2
"	91c	3	1
"	106g	4	2
"	442	3	2
"	889	3	2
Aspergillus unguis Emile-Weil and Gaudin	8f	2	1
"	30b	2	2
"	45e	2	1
"	53c	1	2
"	890	2	2
Aspergillus ustus (Bainier) Thom and Church	29c	2	2
"	89d	1	1
"	133f	3	3
"	137d	2	3
"	891	4	3
"	892	2	1
Aspergillus ustus (Bainier) var. **laevis** Blochwitz	24a–2	3	2
"	893	3	2
Aspergillus versicolor (Vuillemin) Tiraboschi	4g	2	1
"	17d	2	1
"	134c	2	1
"	432	3	1
"	894	2	1
Aspergillus violaceo-fuscus Gasperini	335	3	1
Aspergillus wentii Wehmer	44a	1	1
Basidiomycete (Conidial stage)	589	3	2
"	592	0	0
"	594	1	1
"	806	1	1
"	807	0	1
Beauveria bassiana (Bals.) Vuill.	972	3	2
Blakeslea trispora Thaxter	1019	1	1
Botryodiplodia theobromae Patouillard	78a	1	1
"	145h	2	1
"	166a	2	1
Botryophialophora sp.	571	2	2
Botryosporium pulchrum Corda	907	1	0
"	965	0	0
Botryotrichum piluliferum Sacc. & Marchal	336	1	1
"	337	1	0
"	991	0	1
Botrytis cinerea Persoon	520	1	1
Botrytis sp.	344	1	1
"	578	1	0

Organism	QM Number	Relative Activity on Coconut Oil	Relative Activity on Ricinoleate
Brachysporium oosporum (Corda) Saccardo	665	2	2
Brachysporium sp.	38d	3	2
"	70g	3	2
"	595	1	1
Byssochlamys sp.	438	1	1
Cephaliophora tropica Thaxter	596	1	1
Cephalosporium sp.	107a	1	1
"	124h	1	1
"	127e	1	2
"	597	1	1
"	598	1	1
Cephalothecium roseum Corda	599	1	1
"	936	1	1
Chaetomium atrobrunneum Ames	626	2	2
"	627	1	1
"	952	1	1
Chaetomium causiaeformis Ames	949	1	1
Chaetomium cochliodes Palliser	604	1	1
"	624	3	3
Chaetomium cupreum Ames	954	2	1
Chaetomium elatum Kunze and Schmidt	382	1	1
"	605	1	1
"	606	1	1
Chaetomium funicolum Cooke	33c	2	1
"	34d	1	1
"	35e	1	1
"	145k	1	1
"	155b	1	1
"	383	1	1
"	607	1	1
Chaetomium globosum Kunze	32b	3	2
"	38f	3	2
"	85n	3	1
"	104a	3	2
"	459	3	3
"	608	3	2
Chaetomium indicum Corda	46b	1	1
"	47c	1	1
"	156f	2	1
"	621	1	1
Chaetomium mollipilium Ames	1007	2	2
"	1008	3	2
Chaetomium spirale Zopf	622	4	2
Chaetomium tortile Bainier	895	2	1
Chaetomium turgidopilosum Ames	948	2	1
Chaetomium velutinum Ames	623	1	1
"	950	1	1
"	951	1	1
"	953	1	1
Chaetomium n. sp. of Ames	625	2	1
Circinella spinosa van Tieghem and Le Monnier	537	2	1

Organism	QM Number	Relative Activity on Coconut Oil	Ricinoleate
Circinella sydowi Lendner	629	3	1
Circinella sp.	902	2	1
Cladosporium herbarum Link	17b	1	1
"	52a	2	1
"	55b	1	1
"	71d	2	1
"	120g	1	1
"	121k	2	2
"	122e	2	1
"	279a	1	0
"	489	1	1
"	1027	1	1
"	1028	1	1
Cladosporium sp.	122c	1	1
"	146h	1	1
"	236	1	2
"	279b	1	1
Colletotrichum sp.	533	0	0
Collybia velutipes (Curt.) Lond.	1012	1	0
Coprinus sclerotigenus Ellis and Everhart	933	2	2
Corynespora sp.	569	0	0
Ctenomyces serratus Eidam	256	0	0
Ctenomyces sp.	199	0	
"	287	2	1
"	774	1	1
"	845	1	1
Cunninghamella bertholletiae Stadel	1021	4	2
Cunninghamella blakesleeana Lendner	631	4	3
Cunninghamella echinulata (Thaxter) Saccardo	154f	4	2
Cunninghamella elegans Lendner	634	2	1
Curvularia falcata (Tehon) Boedijn	77a	1	1
Dactylium dendroides (Bulliard) Fries	508	2	1
Fusarium roseum Link	38g	1	1
Humicola fuscoatra Traaen	580	1	1
Memnoniella echinata (Rivolta) Galloway	1c	1	1
Mucor genevensis Lendner	549	1	1
Mucor heterosporus Fischer	615	2	1
Myrothecium verrucaria (Alb. and Schw.) Ditmar ex Fries	460	2	1
Paecilomyces varioti Bainier	822	2	1
"	823	3	1
"	824		2
Penicillium capsulatum Raper and Fennell	2572	2	2
Penicillium chrysogenum Thom	943	2	1
Penicillium citrinum Thom	1a	3	1
Penicillium duclauxi Delacroix	1078	2	1
Penicillium frequentans Westling	2497	2	1
Penicillium funiculosum Thom	443	2	2

Organism	QM Number	Relative Activity on Coconut Oil	Relative Activity on Ricinoleate
Penicillium lilacinum Thom	4e	2	2
Penicillium luteum series	474	2	1
Penicillium martensii Biourge	50a	1	1
Penicillium palitans Westling	919	2	1
Penicillium pusillum Smith	137g	1	1
Pestalotia bicolor Ellis and Everhart	664	3	2
Pestalotia dichaeta Spegazzini	698	2	2
Pestalotia palmarum Cooke	381	2	2
Pestalotia royenae Guba	531	3	2
Pestalotia virgatula Klebahn	478	2	2
"	479	3	2
Pestalotia sp.	2d	3	2
"	119b	2	
"	121L	2	2
"	795	3	2
"	796	3	
Phialophora compacta (Carrion) Binford, Hess & Emmons	260	2	1
Phialophora fastigiata (Lagerberg and Melin) Conant	265	1	1
Phialophora jeanselmei (Langeron) Emmons	270	2	2
Phialophora lagerbergii (Melin and Nannfeldt) Conant	267	0	0
Phialophora pedrosoi (Brumpt) Binford, Hess & Emmons	259	1	1
"	261	1	1
"	262	2	1
Phialophora verrucosa Medlar	264	1	1
"	269	1	1
Phialophora sp.	645	1	1
Pholiota adiposa Fr.	512	0	0
Phomaceae	13e	4	2
"	29b	2	2
"	40c	1	1
"	106d	1	2
"	120k	2	1
"	534	2	2
"	568	0	
"	576	3	2
"	603	2	2
"	618	3	1
"	699	4	3
"	701	2	3
"	702	1	1
"	703	3	3
"	704	2	2
"	798	2	2
"	799	2	1
"	804	2	1
"	830	2	1
"	831	1	1

Organism	QM Number	Relative Activity on Coconut Oil	Ricinoleate
"	832	1	2
"	896	2	2
"	935	3	2
Phymatotrichum sp.	985	1	0
Polyporus sulfureus (Bulliard) Fries	509	0	0
Polyporus versicolor (L.) Fr.	1013	2	1
Pseudocoprinus sp.	801	1	1
Ptychogaster rubescens Boud.	1011	1	0
Pullularia pullulans (deBary) Berkhout	72c	2	2
"	279c	1	1
"	388	3	1
"	802	2	2
Rhizopus arrhizus Fischer	46c	2	2
"	187a	1	2
"	808	2	1
"	809	2	1
"	839	2	1
"	500	3	2
Rhizopus nigricans Ehrenberg	387	2	2
"	810	2	1
"	860	2	2
Rhizopus oryzae Went and Geerlings	811	3	1
Rhizopus sp.	231	1	1
"	1032	3	
Scopulariopsis brevicaulis (Saccardo) Bainier	609	1	1
"	773	1	1
"	813	1	1
"	814	1	1
"	815	1	1
"	816	1	1
Scopulariopsis repens Bainier	399	1	1
Sepedonium sp.	913	0	0
Septonema sp.	818	4	3
Spegazzinia tessarthra (Berk. and Curt.) Saccardo	373c	2	1
Sphaeropsis sp.	47a	2	1
"	104g	2	1
Spicaria violacea Abbott	1031	1	1
Spiroschisma sp. ?	708	2	1
Sporotrichum pruinosum Gilman and Abbott	168	1	1
"	244	1	1
"	303		1
"	591	1	1
"	593	2	1
"	825	1	1
Stachybotrys atra Corda	102a	1	1
Stemphylium botryosum Wallroth	544	2	1
Stereum purpureum Fr.	1014	0	0
Syncephalastrum racemosum (Cohn) Schroeter	57a	2	1

Organism	QM Number	Relative Activity on Coconut Oil	Relative Activity on Ricinoleate
Torula sp.	986	2	1
Trichoderma viride Harz	6a	2	1
"	13b	2	1
Tritirachium roseum van Beyma	164	1	1
Ustilago zeae (Beckm.) Unger	990	1	2
Sporocytophaga myxococcoides (Krzemieniewska) Stanier	B482	1	0
Streptomyces sp.	B1549	1	0

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NEW LICHENS FROM NORTHERN PATAGONIA, WITH NOTES ON SOME RELATED SPECIES

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The new entities described in the present paper are all from the westernmost parts of Argentine Patagonia situated between latitudes 39° and 43° S., chiefly from around the great Cordilleran lakes of Nahuel Huapí (Prov. Río Negro), Futalaufquen and Menéndez (Terr. Chubut) and Lacar and Quillén (Prov. Neuquén). They are based partly on material preserved in the Argentine Museum of Natural Sciences in Buenos Aires (collections made chiefly by Oscar Kühnemann) and partly on specimens collected by the present author on a field trip to those parts of northern Patagonia in 1950. Most of the localities visited lie within the Argentine National Parks of Nahuel Huapí, Lanín, and Los Alerces. At the western ends of the lakes mentioned, where most of the collections were made, the lichen vegetation is extremely rich and luxuriant; it accompanies the species-rich Valdivian rain forest, largely composed of evergreen Antarctic beech (*Nothofagus dombeyi*), bamboos (*Chusquea*) etc., eastwards through the mountain passes from the Chilean side, and the species composing it are for the most part characteristic of the very humid Valdivian floristic region, with some Magellanic elements at the higher altitudes. The finding of a number of undescribed species of lichens in this area is not altogether surprising, because very few data have been published concerning its cryptogamic vegetation. Apart from a few records mentioned by Malme (1899, 1925) and others, there exist only two papers dealing especially with the lichen flora of this part of northern Patagonia: * that of Räsänen (1939), based on a collection made in the Nahuel Huapí National Park by A. Donat, and that of Santesson (1942) on lichens from the same area collected by Ljungner in 1932–34. A semi-popular lichen flora of the Argentine National Parks, by the present author, is now in course of preparation, and the new entities here described were encountered in the elaboration of a large amount of undetermined lichen material being worked up in connection with its compilation. Some apparently new species of *Cladonia* found in the collections were submitted to Dr. Alexander W. Evans (Yale University), who is reporting separately on them in due course.

* The paper "Lichenes argentinienses a cl. Dr. Lorentz in Argentina australi s. patagonica et prope Conceptionem lecti" by J. Müller-Argau (*Flora*, Vol. LXXII, 508; 1889) deals mainly with species from the more arid and floristically quite distinct region to the east of the National Parks.

Verrucaria lacustris M. Lamb (n. sp.)

Thallus epilithicus, effusus, tenuis, obscure cyanescenti-griseus aut chalybaeus, madefactus vix gelatinosus et colore haud mutatus, continuus vel passim subreticulato-rimosus, haud areolatus, opacus, hypothallo obscuro haud cinctus; intus pseudoparenchymaticus, I– , strato basali tenui, olivaceo-fusco sed haud carbonaceo; gonidia 4–8 μ diam., irregulariter disposita. Perithecia sparsa, semi-immersa, tandem hemisphaerico- vel subconico-emergentia, in parte infima thallo tenuiter obducta, dimidio superiori (0.3–0.5 mm. lato) nuda et nigra; ostiolo saepe distincto, minuto, impresso. Excipulum globosum vel depresso-globosum, 170–255 μ latum, integre fuscum; involucrellum crassum, carbonaceum, excipulum superne et lateribus fere usque ad basin tegens, inferne crassescens et extrinsecus productum. Periphyses graciles, ramosae; paraphyses nullae (omnino diffluxae). Sporae 6–8nae, ellipsoideae, incoloratae, simplices, 13.5–15.3 (–17.0) μ longae, 6.5–7.5 (–8.5) μ latae, pariete tenui. — Gelatina hymenialis I + vinoso-fulvescens (nulla praecedente caerulescentia). — Inter species aquae dulcis stirpis *V. aethiobolae* locanda, *V. hydrelae* Ach. et *V. kernstockii* Zschacke proxime ut videtur accedens, a quibus differt excipulo bene et integre infuscato, thallo magis chalybaeo, etc. — In saxis granitoideo-quartziticis praeter litus lacus Verde in Argentina, Patagonia, Chubut, ubi temporibus asperitatis coeli adspersione procellarum facile humectatur: M. Lamb, 1950, no. 5884.

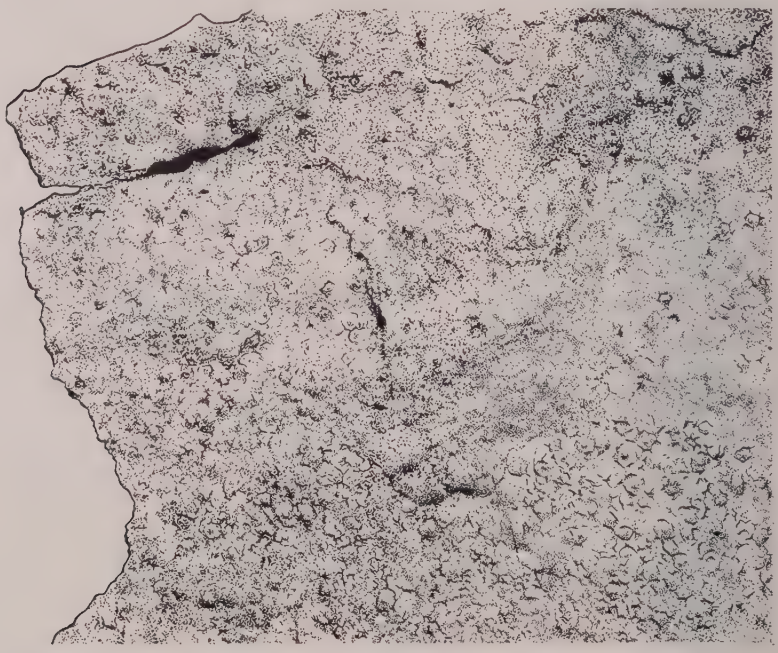


Fig. 1. *Verrucaria lacustris* M. Lamb. Part of the type-specimen ($\times$ 4).

Thallus epilithic, forming irregular confluent patches up to 5 cm. or more in diameter, thin, effuse, not bounded by any dark hypothallus, smooth, even, dark blue-green-gray or "chalybaeous" (comparable to Pl. LII, 35'''' i-k in Ridgway's

"Color Standards," 1912), without any brownish tinge, not changing color when moistened, matt, continuous or in places obsoletely reticulate-rimose, not areolate, not punctate. Perithecia fairly abundant, irregularly scattered, semi-immersed, finally forming hemispherical- or subconical-emergent black verrucae 0.3–0.5 mm. diam., only in the lower half thinly clothed by thallus; matt or rarely subnitid, with the apical ostiole usually ± distinct, minute, impressed.

Thallus 30–65 μ thick, with a somewhat vaguely limited, dark olive-brownish upper cortical layer 6–10 μ thick; basal 10–17 μ also gradually dark olive-brownish (not or hardly carbonaceous); the intervening medullary-algal layer greenish (from the algae), not pigmented, entirely ± filled with algae, which are disposed haphazardly, not in rows. Thallus entirely distinctly pseudoparenchymatic in structure (the cortex and basal layer distinctly so), the cells rounded or oblong, with walls about 0.7 μ thick; those of upper cortex and medulla about 2 μ diam., those of the basal layer slightly larger, 2–3 μ. Algae pale green, globose or oblong, thin-walled, small, 4–8 μ diam. All thalline tissues I–.

Perithecia in section show a globose or slightly flattened excipulum 170–255 μ diam., with entire, dark brown wall about 10 μ thick of tangentially compressed cells 6–10 × 1.5–3.0 μ. Involucrellum well developed, carbonaceous, 65–78 μ thick above, 100–155 μ thick below, lying over the excipulum and extending down its sides almost to its base, where it is wider and angulate-produced; its lowest part separated from the excipulum by a distinct crack. Involucrellum covered to about half-way from the base (or sometimes higher) by a thin thalline layer up to 24 μ thick containing algae. Structure of involucrellum pseudoparenchymatic, with ± isodiametric, rounded or angulose cells 3–4 μ diam., their brown-pigmented walls 0.7–1.0 μ thick. Periphyses present on upper inner wall of excipulum; branched, slender, up to 40 μ long, about 1 μ thick. No paraphyses (diffluxed). Asci soon diffluxed. Spores 6–8 in ascus, irregularly massed, ellipsoid, thin-walled, colorless, simple, 13.5–15.3 (–17.0) × 6.5–7.5 (–8.5) μ. "Nucleus" I + vinous-fulvescent (no preceding blue coloration). (No pycnidia found.)

Fig. 2. *Verrucaria lacustris* M. Lamb. The type-specimen. Structure of the perithecium.

This species is one of the freshwater *Verrucariae* of the *aethiobola*-group, related to *V. hydrela* Ach. and *V. kernstockii* Zschacke (Syn. *V. rheithrophila* Zschacke, *V. minutipuncta* Erichs.). From *V. aethiobola* it differs in the differently colored thallus without any brownish tinge, the larger perithecia, and the smaller spores; from *V. hydrela* in the quite smooth thallus, the dark brown entire excipulum, and the somewhat shorter spores; and from *V. kernstockii* in the more emergent perithecia, dark entire excipulum of larger diameter, and somewhat larger spores. *V. laevata* Ach. has a thinner, much lighter colored thallus, and smaller perithecia. Some species recently described by Servít more or less closely resemble *V. lacustris*: *V. schistosa* Serv. in *Stud. Bot. Čechoslovaca*, Vol. XI, 34: 1950 (differing in its smaller perithecia and smaller spores), *V. kalenskýi* Serv. in *Věstn. Král. České Spol. Nauk*, Vol. IV, 3: 1951 (differing in the punctate-maculate thallus and smaller dimensions of perithecia and excipulum), *V. subhydrela* Serv., *op. cit.*, p. 6 (differing in the smaller, com-

pletely colorless excipulum, the thinner, more adpressed involucrellum, and the longer and somewhat broader spores), and *V. diabasica* Serv. in *Preslia*, Vol. XXIV, 355: 1952 (differing in the partly minutely verruculose thallus and smaller perithecia and excipulum, the latter colorless or almost so at the base). Among Southern Hemisphere species, *V. lacustris* is most closely comparable with *V. riograndensis* Malme (from Brazil), *V. sublaevata* Müll. Arg. (from Brazil), and *V. submargacea* Kn. (from New Zealand); from *V. riograndensis* it differs in the larger perithecia and smaller spores, from *V. sublaevata* in the dark chalybaeous thallus and smaller spores, and from *V. submargacea* also in the distinctly smaller spores.

Collected on granitoid-quartzitic rocks at the edge of the lake, just above water level, certainly inundated during stormy weather. It was of more or less sporadic occurrence, and did not form a continuous supralitoral zone.

Type in Herb. Mus. Nat. Canada, Ottawa; isotype in Herb. Inst. Bot. Darwinion, San Isidro, Buenos Aires.

Sphaerophorus ramulifer M. Lamb (n. sp.)

Thallus caespitosus, erectus, altitudine 2.5–4.0 cm.; rami primarii congesti, subsimplices aut parce irregulariter ramosi, teretes (nec complanati), validi, 0.8–2.0 (–2.5) mm. crassi, pallide cinereo-straminei, hinc inde spurie rubrotincti, opaci, laeves, cortice saepe transversim diffracto, ramulis phyllocladoideis numerosis minutis divaricatis muniti. Ramuli ramis concolores vel paullo pallidiores, ad basin usque 6 mm. longi, ad ramos breviores (0.5–1.5 mm.) et ibidem saepe fasciculato-aggregati. Cephalodia desunt. Apothecia terminalia, primo subglobosa, mox late calyciformia et apice irregulariter dehiscentia, demum 2.5–3.0 mm. lata, receptaculo thallino ramulis minutis vel papillis parce obsito; mazaedium prominens, nigrum, subtiliter fibrosum. Sporae globosae, decolores aut leviter cyanescenti-obscuratae (nunquam fuscae), membrana tenui, pigmento nigricante friabili obductae, simplices, 6.5–8.5 μ latae. — Medulla alba, solida, KHO– , $CaCl_2O_2$– , PD– , I– . — Ad speciem neozelandicam *Sph. nobilem* Zahlbr. proxime accedit, a qua statura humiliori, medulla iodo haud

Fig. 3. *Sphaerophorus ramulifer* M. Lamb. The type-specimen (× 1.25).

reagente, sporis minoribus et forsan aliter coloratis recedit. *Sph. stereocauloidi* Nyl. item neozelandico haud absimile, at defectu cephalodiorum et reactionis iodeticae mox distinctus. — Ad corticem *Fitzroyae* in Argentina, Patagonia, Rio Negro, lacus Frias: M. Lamb, 1950, no. 5977.

Caespitose, forming close, irregular, intricated tufts; primary branches upright,

crowded, 2.5–4.0 cm. high, subsimple or sparingly branched in irregular fashion, terete (not flattened), 0.8–2.0 (–2.5) mm. thick, entirely covered with a smooth, matt, non-pruinose cortex which is often transversely annulate-cracked (in the thicker branches with some cracks in other directions also); color pale grayish-stramineous, in a few places (artificially) stained crimson-reddish. Numerous small disharmonic phyllocladioid branchlets present, both on the primary branches and around their base; terete-coralloid, furcately branched, concolorous with the primary branches or paler (whitish), smoothly corticate, those at the base up to 6 mm. long, those on the primary branches themselves shorter (0.5–1.5 mm.) and often in fasciculate groups; about 0.15 mm. in thickness. No cephalodia present. Apothecia numerous, terminal on the primary branches, at first subglobose, soon dehiscing irregularly at the apex and becoming shallowly cup-shaped; when fully expanded 2.5–3.0 mm. diam. Receptacle corticate, concolorous with the rest of the thallus, smooth or slightly scrobiculate, studded with small reduced phyllocladioid branchlets or papillae; mazaedium prominent, black, finely fibrose.

Cortex of primary branches 100–120 μ thick, in outermost one-third gradually inspersed with sordid yellowish-gray granules, the inner part clear and hyaline; on the outside covered by a colorless, amorphous, necrotic stratum 6.0–8.5 μ thick. Cortex composed of completely gelatinized and fused, very thick-walled hyphae intricated in various directions, only the tubular lumina (1.0–1.7 μ wide) visible in the gelatinous matrix. Inner boundary against the algal-medullary layer $\pm$ even (not of "zigzag" formation). Algal-medullary layer 50–100 μ deep, densely dark grayish-inspersed and $\pm$ opaque in water. Central core compact, without interstices, grayish-cloudy but without visible granules, composed of colorless, fairly thick-walled, $\pm$ discrete hyphae 3.5–6.0 μ thick, closely intricated in various directions, but chiefly in a $\pm$ longitudinal sense. Algae protococcoid, globose, bright green, thin-walled, 5.5–8.5 μ diam. In KHO, nubilation of outer cortex is dissolved with effusion of yellow mist; that of the algal-medullary layer and the central core dissolved without any color. Spores simple, globose, colorless to faintly cyanescent-darkening, but never brown, surrounded by quantities of a friable blackish pigment; thin-walled, 6.5–8.5 μ diam.

Medulla KHO– , $CaCl_2O_2$– , KHO($CaCl_2O_2$)– , PD– (also in the finer branches and younger growing parts), I– .

There are four other known species of *Sphaerophorus* which are provided with the same type of characteristic minute divaricate phyllocladioid branchlets: *Sph. stereocauloides* Nyl., *Sph. jamaicensis* Räs., *Sph. tuckermanii* Räs., and *Sph. nobilis* Zahlbr. *Sph. jamaicensis* belongs obviously to the *melanocarpus*-group, and is distinguished from our species by its compressed thallus-branches and different chemical composition (medulla PD + red). *Sph. tuckermanii* Räs. is a much more slender species, and has the medulla I + blue. *Sph. stereocauloides* differs in the presence of the characteristic cephalodia and has the medulla I + blue. The greatest similarity seems to be with the New Zealand species *Sph. nobilis* Zahlbr., of which unfortunately no authentic material could be obtained for comparison; according to the description (in *Denkschr. Akad. Wiss. Wien, math.-naturw. Kl.*, Vol. CIV, 258: 1941) this agrees well in habitus with *Sph. ramulifer*, but is much larger, up to 16 cm. high, has a positive reaction of the medulla with iodine, a subcorymbose arrangement of the apothecia, and distinctly larger and brown-pigmented spores.

It was found growing in conspicuous tufts towards the base of trunks of *Fitzroya* in open forest near the shore of the lake.

Type in Herb. Mus. Nat. Canada, Ottawa; isotypes in Farlow Herb., Herb. Inst. Syst. Bot. Uppsala, and Herb. Inst. Bot. Darwinion, San Isidro, Buenos Aires.

Psoroma internectens M. Lamb (n. sp.)

Thallus minute squamulosus, squamulis vix 0.5 mm. latis, primum dispersis, mox contiguis et imbricatis, cervinis aut alutaceo-fuscidulis, rotundatis, passim margine angustissime et indistincte pallidioribus, hypothallo inconspicuo nigricanti superpositis,

marginibus liberis aut subliberis; apothecia inter squamulas dispersa, discoidea, sessilia, 0.9–1.8 mm. lata, persistenter plana, disco obscure rufescenti aut rufofusco, opaco, nudo, margine tenui, integro, haud vel vix prominulo, rufofusco (disco concolori vel paullulum pallidiori), demum fere excluso. Thallus latere superiore tantum corticatus, cortice 17–20 μ crasso, indistincte pseudoparenchymatico. Apothecia gonidia et in margine et (parcius) sub hypothecio foventia, strato corticali marginis inferne evoluto, superne deficienti. Hypothecium pallidum, hyphosum, grumosum, strato basali excipulare indistincte pseudoparenchymatico insidens. Hymenium circ. 120 μ altum, superne fulvescens; paraphyses separabiles, apicibus vix incrassatae; asci clavati, 95–100 μ longi. Sporae 6–8nae, uniseriatae aut partim biseriatae, simplices, hyalinae, ellipsoideae, longit. 20–24 μ, crassit. 9–12 μ, apicibus leviter acuminatis aut interdum obtuse apiculatis, episporio sat incrassato et exasperato. — Aspectu *Psoromariam* in memoriam revocat, ab illo genero autem structura lecanorina apotheciorum secernendum et *Psoromeis* veris adscribendum, reliquis speciebus hujus generis margine thallino obscurius colorato et deflexo diversum. — Supra terram arenosam inter muscos in Argentina, Patagonia, Chubut, lacus Menéndez: O. Kühnemann, 1940, no. 4747.

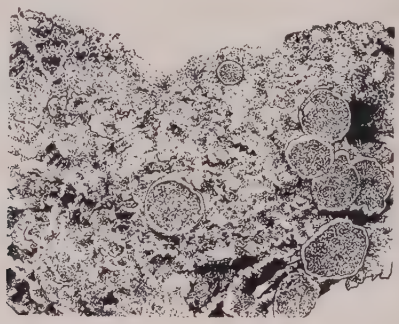


Fig. 4. *Psoroma internectens* M. Lamb. Part of the type-specimen (× 4).

Thallus effuse, in small scattered or confluent patches up to 1 or 2 cm. across, consisting of scattered, contiguous, or finally imbricated, minute, tawny or brownish-buff squamules not over 0.5 mm. diam., which are thin, sometimes very narrowly and indistinctly paler at the margins, on an indistinct, non-zonate, non-fibrous, blackish hypothallus. The scattered squamules are slightly free at the edges, the imbricate ones completely free at the edges. Lower side of squamules concolorous with upper side or slightly paler, or blackish from the adherent hypothallus, not rhizinose. Upper surface of thallus smooth, matt. Apothecia fairly numerous, irregularly scattered among the squamules, discoid, sessile, constricted at base, 0.9–1.8 mm. diam., persistently plane, with dark reddish or red-brown, smooth, matt, naked disc and thin, entire, not or hardly prominent, reddish-brown margin (concolorous with, or somewhat lighter than, the disc), which may finally be ± reflexed and almost excluded. In outward appearance, the apothecia look biatorine. The margin on its outer side is occasionally minutely and obsoletely verrucose-crenulate, but this not noticeable except by close examination.

Thalline squamules 100–140 μ thick; upper cortex 17–20 μ thick, colorless to faintly sordid yellowish, ± clear or slightly cloudy in section (but without granules), indistinctly pseudoparenchymatic with isodiametric, rounded cell-lumina 3.5–5.0 μ diam.; interior completely filled with symbiotic algae embedded in compact hyphal tissue; no distinct lower cortex developed. Hypothallus consisting of lax, brown or colorless hyphae about 3.5 μ thick entangled with the particles of the substratum. Algae pale green, globose, 8–14 μ diam., thin-walled.

Margin of apothecia distinctly corticate only in its lower part; the upper part has the algae reaching almost to the surface, covered only by a ± amorphous, colorless to pale brownish weft of indistinct gelatinous hyphae. Cortex of lower part 30–120 μ thick, becoming thicker downwards, colorless and hyaline, or reddish-brown in outermost 10–17 μ, pseudoparenchymatic, with oblong, radially parallel, thin-walled cells 7–12 × 4–7 μ. Algae abundant and crowded in the margin, also present in ± scattered groups below the lower excipular stratum. Some colorless or brownish rhizoid-hyphae are developed on the outside of the apothecia at the base. Hypothecium 35–70 μ deep, grayish-cloudy in section, compactly hyphose, grumose, resting on a colorless or faintly yellowish, indistinctly pseudoparenchymatic, lower excipular stratum 35–60 μ thick with ± isodiametric, indistinct cell-lumina 2.5–4.0 μ diam.; this layer running up at the sides of the hymenium to form a ± obsolete, non-prominent proper margin. Hymenium about 120 μ high, fulvescent in uppermost 9–13 μ, otherwise

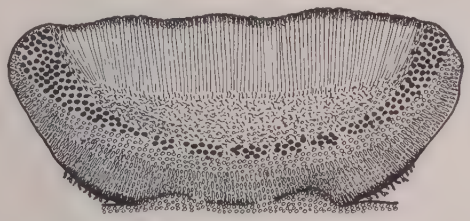


Fig. 5. *Psoroma internectens* M. Lamb. The type-specimen. Section of an apothecium.

colorless and hyaline. Paraphyses separable in water, involved in mucilage and ± gelatinous, 1.5–2.5 μ thick, simple or branched, ± irregular but not articulated; not or hardly thickened at apices, where they are fused into a gelatinous, brownish-yellow epithecium. Asci clavate, 95–100 μ long, with wall about 1.5 μ thick at sides, at the apex gelatinously thickened to 15–20 μ. Spores 6–8 in ascus, uniseriate or partly biseriate, ellipsoid, slightly pointed or sometimes bluntly apiculate at ends, with uneven-scabrid, ± gelatinous wall up to 1.5 μ thick, and often vacuolate contents; 20–24 × 9–12 μ. Hymenium I + light blue then wine-red (only the asci stained).

The thallus, consisting of minute, ± imbricated squamules, strongly resembles that of the two species of *Psoromaria*, *Ps. descendens* and *Ps. subdescendens*, and the apothecia outwardly resemble those of the latter species, but differ anatomically in the presence of algae in the margin and below the lower excipular stratum; their structure is fundamentally the same as in other species of *Psoroma*, but the cortex of the thalline margin is pushed down and reflexed, giving a biatoroid appearance; in *Psoromaria* the apothecia are truly biatorine, not containing algae (see M. Lamb in *Lilloa*, Vol. XXVI, 408: 1953).

Collected by Oscar Kühnemann on sandy soil among mosses at Lago Menéndez in the western part of the Los Alerces National Park (Chubut).

Type in Herb. Mus. Argent. Cienc. Nat., Buenos Aires; isotype in Herb. Mus. Nat. Canada, Ottawa.

Parmeliella granulata M. Lamb (n. sp.)

Thallus foliaceo-crustosus, plus minusve orbicularis, ad 10 cm. latus, margine laciniato-lobatus, in centro crustaceo-squamulosus, undique (saltem in herbario) alutaceus, opacus, peripheriam versus in superficie granulato-scabrosus (ut in *Peltigera scabrosa*); subtus et passim margine tomento rhizinoso caeruleoatro vel partim pallescente dense vestitus. Laciniae marginales longit. 4–8 mm., latit. 1.5–4.0 mm., crassit. circ. 0.2 mm., irregulariter divisae et lobatae, planiusculae, haud sulcatae;

thallus in parte centrali ad 2 (–3) mm. crassus, squamulis coacervatis, concrescentibus, rotundatis aut varie lobato-crenatis, laevigatis aut thalli marginem versus scabriusculis. Apothecia numerosa, sessilia, rotundata, basi modice vel bene constricta, 0.5–1.0 mm. lata, ab initio nigra aut fusconigra, nuda, primo plana et margine proprio mediocri integro concolori cincta, dein mox convexa et immarginata; excipulum integrum, inferne incoloratum et sat grosse pseudoparenchymaticum, lateribus extus anguste fuscescens et ex hyphis radiantibus contextum; hypothecium isabellinum, ad 270 μ crassum. Hymenium 80–100 μ altum, superne obscure olivaceo-fuscescens aut fuligineum, caeterum decolor et hyalinum, paraphysibus discretis, simplicibus. Sporae 8nae, simplices, incoloratae, ellipsoideae, vulgo apicibus acutiusculae, 12–15 $\times$ 5.5–7.0 μ, pariete tenui et laevigato. — Thallus extus intusque KHO– , $CaCl_2O_2$– , PD– , I– ; hymenium I + persistenter caerulescens, epithecium KHO– , HNO_3 + violaceo-rubescens. — Similitudinem quamdam, quod ad habitum attinet, cum *P. plumbea* (Lightf.) Müll. Arg. ostendit, at colore et scabrositate thalli diversa. — Ad cortices in Argentina, Patagonia, Neuquén, prope lacum Quillén: O. Kühnemann, 1943, nos. 789, 791 pr. p. (typus speciei), 795.

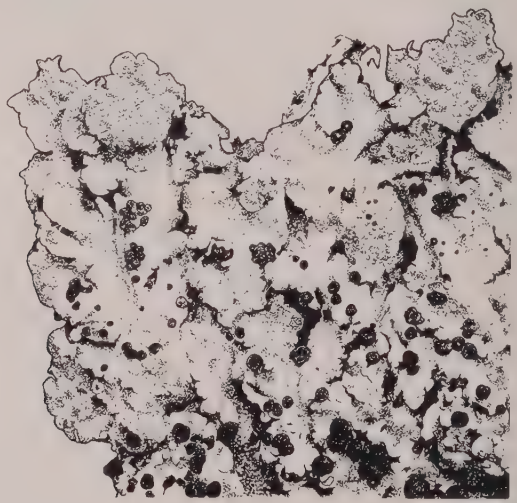


Fig. 6. *Parmeliella granulata* M. Lamb. Part of the type-specimen showing peripheral lobes ($\times$ 4).

Description of the type-specimen (*Kühnemann no. 791 pr. p.*): Thallus foliose-crustose, adpressed, $\pm$ orbicular, up to 5–10 cm. diam., laciniate-lobate at periphery, crustose-squamulose in central part, alutaceous in color ("Cinnamon-Buff," "Clay Color," or "Tawny Olive" in Pl. XXIX of Ridgway's "Color Standards"), quite matt, distinctly scabrid-granulate towards the periphery (as in *Peltigera scabrosa*). Peripheral laciniae 4–8 mm. long, 1.5–4.0 mm. broad, loosely adpressed to substratum, irregularly branched, rounded and lobate-crenate, about 0.2 mm. thick, $\pm$ plane, not striate or sulcate. Central part of thallus consisting of heaped-up and concrescent squamules forming a $\pm$ continuous, uneven crust up to 2 (–3) mm. thick; squamules rounded or irregularly lobate-crenate, 0.8–1.3 (–2.0) mm. diam., up to 0.3 mm. thick, with smooth surface in central parts, becoming gradually scabrose towards periphery of thallus. Underside of thallus with a dense, felted, green-blackish (rarely pallescent) mat of rhizinae, which is visible in places also at the periphery. Thallus externally and internally KHO– , $CaCl_2O_2$– , PD– ; medullary hyphae I– .

Apothecia numerous in central part of thallus, lecideine, scattered or crowded together and sometimes ± confluent, sessile, round, moderately to well constricted at base, 0.5–1.0 mm. diam., black or brown-blackish from the first, matt or slightly nitid, naked, at first plane with ± distinct, moderate, entire, concolorous proper margin, then soon becoming moderately to strongly convex and immarginate.

Thallus corticate on upper side only; cortex pale sordid yellowish or faintly brownish (almost colorless in very thin section), not nubilated, irregular on account of scabrosity, 45–95 μ thick, pseudoparenchymatic, of isodiametric cells with rounded or ± angulose lumina 4.5–9.0 μ diam. and walls 1.5–2.0 μ thick. Algal stratum irregular, somewhat dispersed, 30–90 μ deep; algae Nostocoid, sordid aeruginose or pale blue-green, round, 3–4 μ diam., enclosed in clumps in thin colorless slime-sheaths, no concatenate arrangement apparent. Medulla loose, almost arachnoid, up to 400 μ thick, colorless or in places slightly pale brownish-nubilated, of thin-walled, colorless hyphae 3.0–3.5 μ thick loosely intertexted in various directions. On underside of thallus the medulla goes over gradually into matted, dirty aeruginose, thin-walled, rhizoidal hyphae 3.0–4.5 μ diam.

The apothecia contain no algae. Excipulum entire, developed both at sides and below apothecium; at sides 95–125 μ thick, not nubilated, ± colorless internally, in outermost 20–30 μ gradually pale sordid brownish; composed of strictly radiate-parallel, confluent and conglutinated hyphae 3–4 μ thick with walls of moderate thickness. Lower part of exciple below hypothecium ± colorless, hyaline, 45–65 μ thick, ± grossly pseudoparenchymatic with oblong, ± vertically elongated cells 8–13 × 6–9 μ, their walls up to 3 μ thick, but showing transition to radiate hyphae at the sides of the exciple. Hypothecium up to 270 μ thick, sordid yellowish or isabelline and ± clear (± colorless in very thin section), in the upper and greater part composed of densely compacted or partly indistinctly pseudoparenchymatic, moderately thick-walled hyphae 3–4 μ diam., closely intertexted in various directions (in upper subhymenial 60–70 μ ± elongated and vertically parallel); lower 45–65 μ of hypothecium gradually more distinctly pseudoparenchymatic, with isodiametric, ± round cells 4.5–6.0 μ diam. (walls about 1.5 μ thick), showing transition into the more grossly pseudoparenchymatic basal excipular layer. Hymenium 80–100 μ high, ± abruptly dark olivaceous-brown or brown-blackish in uppermost 12–18 μ, otherwise colorless and hyaline. Paraphyses discrete in water, 1.5–2.0 μ thick, simple, not articulated, at tips clavate-capitate up to 4.5 μ and there brownish-fuliginous (KHO– , HNO_3 + dark purple-crimson). Asci clavate, 60–80 × 10–15 μ, with wall about 1 μ thick at sides, thickened up to 10 (–15) μ at apex. Spores 8, biseriate or ± uniseriate in ascus, simple, colorless, ellipsoid, usually obtusely or ± acutely pointed at ends, 12–15 × 5.5–7.0 μ, with thin smooth wall. Hymenium I + persistently dark blue (only the asci stained).

The other two specimens collected in the same locality by Kühnemann are identical with the holotype, and indeed seem to be parts of the same collection. *P. granulata* resembles *P. plumbea* (Lightf.) Müll. Arg. in the habitus and form of the thallus, but differs in the alutaceous color and noticeably chagrined-scabrose surface of the peripheral parts, reminding strongly of *Peltigera scabrosa*. It may be related to *P. diffracta* Müll. Arg. (from Australia), but that is a saxicolous species with a more distinctly diffract-areolate thallus and pale, pseudolecanorine apothecia. *P. vieillardi* Müll. Arg. from New Caledonia has a different type of scabrosity, due to brown verruculae on the otherwise smooth and ± shining surface, and differs also in the pale underside with marginal rhizinae, and the larger and thickly margined apothecia.

Type in Herb. Mus. Nat. Canada, Ottawa; isotype in Herb. Admin. General Parques Nacionales, Avda. Santa Fe 690, Buenos Aires.

Parmeliella concinna M. Lamb (n. sp.)

Thallus plagulas sparsas orbiculares 5–12 mm. latas efficiens, effigurato-laciniatus, cinereo- aut glaucescenti-alutaceus, opacus, haud sorediosus; laciniae marginales

radiantes, substrato laxe adpressae, 0.5–1.3 mm. longae, 0.3–0.7 mm. latae, planae aut leviter concavae, laeves et glabrae, irregulariter divisae et rotundato-crenatae, subtus ambitu anguste liberae, pallidae, glabrae, laevigatae; laciniae centrum thalli versus magis confluentes et ad margines minutissime squamuliferae (sed haud isidiatae). Hypothallus obsoletus aut nullus. Apothecia numerosa, partem centralem thalli sparsim tegentia, rotundata, basi leviter vel modice constricta, 0.5–0.9 mm. lata, carneo-alutacea aut pallide testaceo-fuscescentia, opaca et nuda, primitus plana et margine proprio pallidiore cincta, denique immarginata et modice convexa. Excipulum integrum, pseudoparenchymaticum, hyalinum aut tantum extrinsecus angustissime fuscescens. Hypothecium incoloratum aut isabellinum, compacte hyphosum, inferne sensim magis pseudoparenchymaticum. Hymenium 90–100 μ altum, totum hyalinum, epithecio nullo; paraphyses discretae, simplices, crassitudine mediocri. Sporae 8nae, ellipsoideae, apicibus rotundatae vel vix acuminatae, simplices et hyalinae, 13.5–16.0 $\times$ 6–8 μ, pariete tenui et laevigato. — Thallus extus intusque KHO– , $CaCl_2O_2$– , PD– . — *P. thysanotae* (Stirt.) Zahlbr. (e Nova Zelandia) arcte affinis, thallo orbiculari-effigurato et apotheciis minoribus diversa. Forsan prope *P. amphibolam* (Kn.) Müll. Arg., etiam in Nova Zelandia inventam, locanda, at sporis haud distincte apiculatis et thallo esorediato distinguitur. — Ad truncos combustos in Argentina, Patagonia, Chubut, prope litora lacus Verde: M. Lamb, 1950, no. 5879.

Fig. 7. *Parmeliella concinna* M. Lamb. Part of the type-specimen on carbonized wood ($\times$ 4).

Thallus forming small scattered orbicular effigurate patches 5–12 mm. diam. on the bare carbonized lignum; composed of radiating, loosely adpressed laciniae, grayish-alutaceous or sordid yellowish-glaucescent (between "Citrine-Drab" and "Buffy

Brown" in Ridgway's "Color Standards," Pl. XL), matt, not isidiate or sorediate. No dark hypothallus developed. Laciniae small, 0.5–1.3 mm. long, 0.3–0.7 mm. broad, plane or slightly concave, irregularly divided, rounded and crenate at the ends, not paler at the margin; towards center of thallus confluent and with the edges dissected into minute rounded squamules up to 0.15 mm. diam., but not truly isidiate. Surface of laciniae smooth, glabrous. Underside of peripheral laciniae free from the substratum, glabrous, smoth, pale (isabelline or faintly brownish); no rhizoids or hypothallus present. Thallus externally and internally KHO– , $CaCl_2O_2$– , PD– . Apothecia numerous in central part of thallus, sessile on the laciniae, round, 0.5–0.9 mm. diam., buff-flesh-colored or pallid testaceous-brownish (approx. "Sayal Brown" in Ridgway, Pl. XXIX), matt, naked, slightly to moderately constricted at base, at first plane with thin, entire, hardly prominent, paler (carneous-yellowish) proper margin, then finally becoming moderately convex and immarginate.

Thallus corticate on upper side only. Cortex 45–55 μ thick, colorless, clear, grossly pseudoparenchymatic, with isodiametric, rounded or obtusely angulose cells 7–14 μ diam., with walls 1.5–2.5 μ thick. Medulla colorless, clear, thin, about 30 μ deep, of $\pm$ closely compacted, variously intricated or mainly $\pm$ longitudinally running, thin-walled hyphae about 3 μ thick. Algal stratum about 45 μ deep, $\pm$ continuous. Algae blue-green, $\pm$ globose, 5–9 μ diam., in irregular clumps (not in chains).

The apothecia contain no algae. Excipulum entire below apothecium, colorless and hyaline (or faintly brownish in outermost 6–10 μ), grossly pseudoparenchymatic, of isodiametric or radially oblong cells 7–15 μ diam., their walls 1.5–3.0 μ thick. Hypothecium colorless (or isabelline in thicker sections), not nubilated, 90–120 μ deep, of compacted and intricated hyphae 1.5–3.0 μ diam., in lower part becoming gradually minutely pseudoparenchymatic and with transition into the excipulum. Hymenium 90–100 μ high, entirely colorless and hyaline (no colored epithecium). Paraphyses discrete, simple, 1.5–3.0 μ thick, at tips clavate-capitate up to 4.5 μ and there occasionally slightly moniliform-constricted. Asci clavate, 70–80 $\times$ 8–10 μ, persistently blue with Iodine, with gelatinous wall 1.0–1.5 μ thick at sides, slightly thickened at apex (about 4 μ). Spores 8, uniseriate or subbiseriate in ascus, simple, colorless, ellipsoid, not or hardly pointed at ends, 13.5–16.0 $\times$ 6–8 μ, with smooth wall about 0.7 μ thick.

Parmeliella thysanota (Stirt.) Zahlbr., described from Chatham Island, New Zealand, obviously comes very close to the present species, to judge from the description. Its apothecia are however larger, up to 1.5 mm., and the thallus is of crowded, ascendant laciniae, not orbicular-effigurate. *P. microphylloides* (Nyl.) Zahlbr. (from Chile) has a more granulate thallus and distinctly smaller spores, 8–9 $\times$ 4–6 μ. *P. nigrocincta* (Mont.) Müll. Arg. and the closely related *P. miradorensis* Vain. are quite distinct from the present species in having a conspicuous black limiting hypothallus; a cotype of *P. miradorensis* was examined in the Farlow Herbarium. *P. amphibola* (Kn.) Müll. Arg., from New Zealand, could not be obtained for comparison, but if Knight's description is correct it should have the thallus gray-sorediate at the margins and distinctly apiculate spores.

Numerous well-fruited thalli were found over the carbonized surface of a fallen burnt tree trunk in open forest near the shore of the Lago Verde, at the west end of the Lago Futalaufquen.

Type in Herb. Mus. Nat. Canada, Ottawa; isotypes in Farlow Herb., Herb. Inst. Syst. Bot. Uppsala, and Herb. Inst. Bot. Darwinion, San Isidro, Buenos Aires.

Pseudocyphellaria exanthematica M. Lamb (n. sp.)

Thallus foliaceus, sat late expansus (7–15 cm. latus), lobato-laciniatus, laciniis brevibus aut sat elongatis, (0.3–) 0.5–1.0 cm. latis, ramosis, axillis rotundatis, apicibus rotundatis aut truncatis, lateribus laciniolis seu foliolis permultis simplicibus aut ramosis, 0.4–1.8 mm. latis munitis; superne fusco-glaucescens aut pallide rufofuscescens, haud scrobiculatus, opacus vel nonnihil nitidus, pustulis minutisismis nu-

merosissimis pallide rufofuscescentibus (ad instar variolarum vel morbillorum) crebre obsitus; inferne centrum versus fuscescens et obscure tomentosus, peripheriam versus pallide alutaceus et glabrescens, pseudocyphellis parvis, albis, planis aut leviter prominentibus munitus. Medulla alba. Soredia et isidia desunt. Gonidia palmellacea, laete viridia. (Apothecia tantum juvenilia visa, ad 0.7 mm. lata, margine subintegro thallo subconcolori et gonidiis destituto, disco concavo rufofuscescenti, hypothecio leviter rufofuscescenti, hymenio solummodo paraphysibus constituto.) — Thallus extus reagentibus immutatus; medulla KHO + lente fuscoflavescens, PD + rubescens (praesertim in strato gonidiali), $CaCl_2O_2$ — . — Laciniis lateribus microphyllino-dissectis et superficie thalli peculiariter morbillose exasperata jam statu sterili mox distinguenda. — In cortice muscoso *Nothofagi* in Argentina, Patagonia, Río Negro, lacus Frias: M. Lamb, 1950, no. 5986.

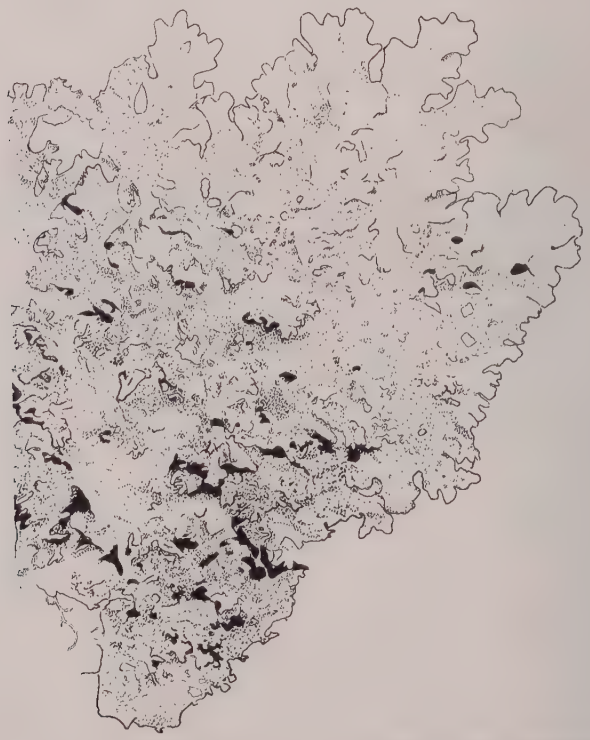


Fig. 8. *Pseudocyphellaria exanthematica* M. Lamb. Part of the type-specimen (× 1).

Thallus 7–15 cm. diam., ± rigid and subcoriaceous in the dry state, lobate-laciniate with short to ± elongated, sublinear laciniae (0.3–) 0.5–1.0 cm. wide; laciniae branched with rounded axils, rounded or truncate at the apices, producing at their edges large numbers of simple or branched, microphylline laciniolae 0.4 1.8 mm. wide; upper surface even (no scrobiculation), brownish-glaucescent to pale reddish-brown, matt or subnitid, without pseudocyphellae, but thickly strewn with minute, pale reddish-brown, pustular excrescences up to 0.05 mm. diam., resembling the markings of smallpox or measles. Under surface brown towards the center, with

a short, coarse, spongy-fibrous, dark tomentum, towards the periphery pale alutaceous and glabrous, matt or subnitid, smooth or in places faintly wrinkled-scrobiculate, not bullate or costate. Pseudocyphellae moderately abundant, pure white, small, up to 0.5 mm. diam., round or sometimes oval, plane to slightly convex-erumpent, powdery. Medulla white. Some immature apothecia present, up to 0.7 mm. diam., mostly superficial but a few also marginal or submarginal; the thickish, prominent, entire or ± irregular margin concolorous with the thallus or gradually reddish-brown on the inner side, the concave disc reddish-brown, matt, naked.

Thallus in section 150–260 μ thick. Upper cortex pseudoparenchymatic, 30–50 μ thick, clear, yellow or yellow-brownish in its outer half, with rounded, isodiametric cells 3.5–7.0 μ diam., their walls about 1.5 μ thick. Algal stratum ± continuous, 35–60 μ deep; algae bright green, separate, round, thin-walled, 7–15 μ diam. Medulla inspersed and ± opaque in section from a yellowish-gray nubilating substance; its hyphae colorless, thin-walled, 3.0–4.5 μ thick, closely or ± loosely interwoven. Lower cortex 35–60 μ thick, clear, faintly yellowish to almost colorless, pseudoparenchymatic with rounded, isodiametric cells 3.5–6.5 μ diam. (walls 1.5–3.0 μ thick). The pustular excrescences in section are merely thickenings of the normal cortex, without peculiar structure, but often with a more intense reddish-brown pigmentation. Surface of thallus KHO– , $CaCl_2O_2$– , PD– ; medulla KHO + (slowly) brownish-yellow (chiefly in the algal layer), $CaCl_2O_2$– , PD + (slowly) red (chiefly in the algal layer), $FeCl_3$ + faintly purple-violascent.

A section through one of the immature apothecia shows that the margin contains few or no algae; the algal stratum of the thallus runs up into the pedicel of the apothecium, but does not extend above the base. Apothecial margin ± brownish and cloudy in inner part, colorless and hyaline in outer part; composed of radiately parallel, gelatinously conglutinated hyphae with short thick-walled cells 6.5–10.0 μ diam., the rounded lumina giving a ± pseudoparenchymatic appearance. Hypothecium faintly reddish-brown. Hymenium immature, without asci, consisting of closely packed paraphyses only, about 100 μ high, faintly brownish-yellow in its uppermost part.

In the shape of the thallus lobes and in the microphylline lobules at their margins, this species resembles the *Pseudocyphellariae: homalosticta* Vain., *multipartita* Vain., *phaeorhiza* Vain., *polyschista* (Mey. & Flot.), *subvariabilis* (Nyl.) Vain., *prolificans* (Nyl.) Vain., and *psilophylla* (Müll. Arg.), but all of these have a perfectly smooth and even upper surface. A Chilean species, described by Nylander as *Sticta valdiviana* (apud Stizenberger in *Flora*, Vol. LXXXI, 115: 1895) with a very short and incomplete diagnosis ("Similis vel subsimilis *S. prolificanti* sed reactione thalli ut in *S. Billardierii* (K +). Variat etiam thallo subfaveolato.") seemed to come very close to the present species, but Dr. Ö. Szatala, who kindly compared our material with Nylander's type-specimen, stated *in litt.* that the latter differs in its quite smooth and non-pustulate upper surface and thinner, more fragile thallus of a darker (brown) color. He supplied the following emended diagnosis of "*Sticta valdiviana*" Nyl., based on the type-specimen (Herb. Nyl. no. 33470): "Thallus laciniato-divisus, laciniis elongatis, 0.3–0.6 mm. latis, subcanaliculatis, superne leviter et obsolete scrobiculato-inaequalis, laevibus et nitidis, obscure fuscis, margine numerose v. rarius superne hinc inde sparse microphyllino-isidiosis, K + lutescens, Cl– , KCl– , subtus pallide ochraceus versus apicem omnino nudus, nitidiusculus, centro densissime tomentoso rhizinosus, rhizinis usque ad 0.1–0.3 mm. longis, fasciculato-ramosis, pallide v. obscure fuscidulis; pseudocyphellis albis, 0.1–0.2 mm. latis, pulverulentis, haud prominentibus; medulla alba. Cortex superior 30–40 μ latus, intis albidus, extus pallide fusco-flavescens, distincte pseudoparenchymaticus, cellulis sphaericis, oblongis v. varie angulatis, ca. 3–6 μ latis et extus strato tenui, hyalino, amorpho, ca. 2–5 μ lato tectis, constitutus. Cortex inferior 20–30 μ latus, omnino pallide fuscescens, distincte pseudoparenchymaticus, cellulis 2–3 μ latis, constitutus. Gonidia globosa, protococcoidea, 10–15 μ lata, membrana incrassata. Sterilis." The type was collected in Chile, near Valdivia, by H. Hahn. The present author does not intend to make here formal

new combinations of the species *polyschista*, *psilophylla* and *valdiviana* under *Pseudocyphellaria*, as he has not made a sufficient study of them, and they may be synonyms of earlier described species.

Only one specimen was seen, but plentifully and well developed, on the mossy trunk of a "Coihue" (*Nothofagus dombeyi*) in open woods near the shore of Lago Frias near the western end of Lago Nahuel Huapí.

Type in Herb. Mus. Nat. Canada, Ottawa; isotypes in Farlow Herb., Herb. Inst. Syst. Bot. Uppsala, and Herb. Inst. Bot. Darwinion, San Isidro, Buenos Aires.

Pseudocyphellaria hirsuta (Mont.) Malme, f. **leucosticta** M. Lamb (n. f.)

A forma typica speciei pseudocyphellis omnino albis vel albidis, nec luteis, differt.— Argentina, Patagonia, Chubut, lacus Futalaufquen: O. Kühnemann, 1941, no. 5449 (holotypus); lacus Menéndez: O. Kühnemann, 1940, no. 4752; lacus No. Uno: O. Kühnemann, 1941, no. 5465; Río Negro, lacus Nahuel Huapí, insula Victoria, Puerto Radal: R. Pérez-Moreau, 1940, no. 4541.

The specimens are in every way typical of *Ps. hirsuta* except in having white pseudocyphellae. In the normal species some of the older pseudocyphellae may lose their yellow color by being worn down to the white medulla, but in this form all the pseudocyphellae, even the youngest, are without yellow color.

Type and other specimens cited in Herb. Mus. Argent. Cienc. Nat., Buenos Aires; isotype in Herb. Mus. Nat. Canada, Ottawa.

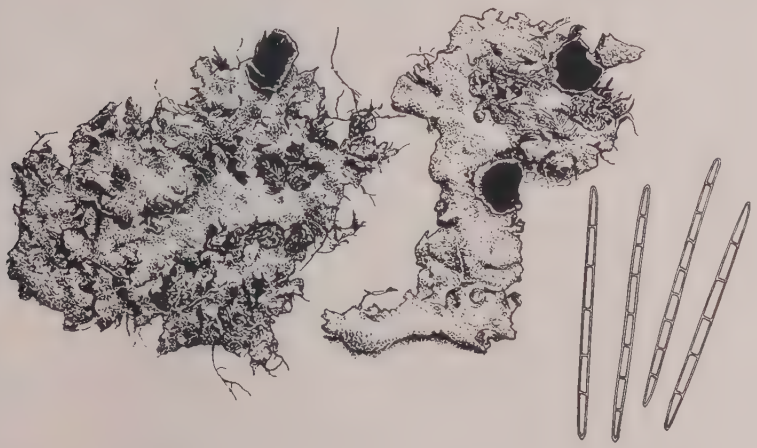
Nephroma (Eunephroma) **kuehnemannii** M. Lamb (n. sp.)

Thallus late expansus, laxe adpressus, haud adscendens, irregulariter laciniato-lobatus, lobis 3–5 cm. longis, 0.7–1.3 cm. latis, marginibus varie incisis, superne stramineo-fuscescens, glaber, nitidus, inferne totus pallidus et ubique rhizinis pallidis aut fuscescentibus villoso-vestitus. Isidia et soredia desunt, cephalodia tamen in pagina infera thalli sparsa, concoloria aut pallide fuscescentia, subglobosa, ad 0.8 mm. lata, laevia, algas Nostochineas foventia. Medulla albida (nec flavescens); gonidia protococcoidea, pallide viridia. Apothecia terminalia, mox sese sursum revolventia, rotundata aut oblonga, 4–9 mm. lata, disco plano aut concaviusculo, obscure rufofusco et nudo, margine thallino sat prominulo, irregulari, saepe discisso, receptaculo glabro, minute verruculoso- aut areolato-aspero. Hypothecium subdecolor, hymenium 95–115 μ altum, superne fulvo-fuscescens; sporae 5–6 (–8 ?)nae, incolores, aciculari-cylindricae, rectae, utrinque obtuse acuminatae, 5–8-septatae, longit. 68–95 μ, crassit. 3.0–3.5 μ. — Medulla KHO tantum indistincte fuscescens, $CaCl_2O_2$– vel partim flavescens, PD + bene flavescens, I– . — Species peculiaris, praesertim sporis perlongis et multiseptatis et cephalodiis veris in pagina infera thalli dignota, obiter visa *N. patagonico* Kphbr. haud absimile, nullae attamen alii speciei arcte relata. — Corticola inter muscos in Argentina, Patagonia, Chubut, lacus Menéndez, loco dicto "Alerzal del Norte": O. Kühnemann, 1941, no. 5485.

On bark, among mosses. Thallus forming extensive, ± continuous patches up to 15 cm. or more across, composed of irregular branching laciniae or elongated lobes 3–5 cm. long, 0.7–1.3 cm. broad, loosely adpressed, not ascendant, irregularly incised at the edges. Upper side stramineous-fuscescent (between "Honey Yellow" and "Isabella Color" on Pl. XXX of Ridgway's "Color Standards"), smooth, nitid, without isidia or soredia; underside concolorous or paler (ochraceous-whitish), not blackening, matt, in all places, except at the extreme tips of the laciniae, villose with shaggy, whitish to brownish, matted rhizinae up to 1.5 mm. long. Scattered cephalodia present on underside; concolorous with underside or pale brownish, subglobose, up to 0.8 mm. diam., smooth, often cracked, containing *Nostoc*. Medulla white or whitish, without any yellow tinge. Apothecia fairly numerous, terminal on laciniae, formed on the underside and then reflexed to face upwards; round or oblong, 4–9 mm. diam., plane or slightly concave, with dark red-brown, matt or subnitid, naked disc

and prominent, irregular thalline margin 0.3–1.0 mm. wide, which is often torn open to expose the medulla. Underside (i.e. original upper side) of apothecium corticate, minutely verruculose or areolate-verruculose.

Thallus corticate on both surfaces; upper cortex 30–37 μ thick, pseudoparenchymatic, stained dark yellowish (without granules) in outermost 11–17 μ, the inner part colorless and hyaline; cells ± isodiametric, obtusely angulose, 6–9 μ diam., with walls about 1.2 μ thick. Algal stratum 20–35 μ deep, pale green; algae protococcoid, pale green, globose, thin-walled, 13–22 μ diam., without visible pyrenoid. Medulla entirely sordid yellow-brownish-nubilated with minute granules and semi-opaque in section, composed of colorless, thin-walled hyphae 2–4 μ thick fairly compactly intricated in various directions or predominantly horizontally parallel. Lower cortex



Figs. 9 & 10. *Nephroma kuehnemannii* M. Lamb. The type-specimen (× 1); spores (× 450).

11–35 μ thick, faintly dull yellowish in section, not nubilated, pseudoparenchymatic, of isodiametric, rounded cells 3.5–4.5 μ diam. with rather thick walls (1.5–2.5 μ). Rhizinae dull yellowish in section, not nubilated, composed of elongated, parallel cells 13–20 μ long, 3–4 μ wide, with walls up to 1.7 μ thick.

Apothecia corticate on lower side (i.e. original upper side) with an uneven-verrucose, pseudoparenchymatic cortex up to 70 μ thick, sordid yellowish-nubilated in its outer half, colorless and hyaline in its inner half, with isodiametric or vertically oblong cells 5–9 μ diam., the colorless walls 1.5–2.0 μ thick. Algal stratum continuous, 50–85 μ deep. Medulla sordid yellow-brownish-nubilated, as in the thallus, running up into the apothecial margin. Apothecial margin usually without algae, composed of medullary hyphae and an outermost, clear, yellowish, gelified, indistinctly pseudoparenchymatic cortical layer about 35 μ thick; or sometimes ecorticate with the medulla exposed on the surface. Hypothecium 70–80 μ deep, clear, colorless in lower half, faintly sordid yellowish in upper half, composed of compactly intricated hyphae 2–3 μ thick. Hymenium 95–115 μ high, yellow-brownish in uppermost 10–14 μ, otherwise colorless and hyaline. Paraphyses separable in water, 3.0–3.5 μ thick, simple or branched, thin-walled, not articulated, but at the apices often submoniliform and there thickened (up to 5 or 6 μ) and faintly yellowish. Asci clavate, 90–100 μ long, 12–15 μ broad, with wall 1.0–1.5 μ thick at sides, not or only slightly thicker at the apex. Spores seen 5 or 6 in ascus, packed ± straight and parallel, acicular-cylindrical,

5–8-septate, colorless, straight, bluntly pointed at the ends, often more tapered towards one end, 68–95 × 3.0–3.5 μ. Hymenium light blue, then yellow, with Iodine.

Medulla of thallus $FeCl_3$ + reddish-purple, KHO + faintly brownish, $CaCl_2O_2$– or in places + yellow, PD + good persistent yellow, I– .

A very distinct and rather peculiar species on account of the cephalodia on the underside and especially the long and multiseptate spores; the spores are seldom over 3-septate in other species of *Nephroma*. Seen from the upper side, it looks not unlike *N. patagonicum* Kphbr. (Syn. *N. analogicum* Nyl.), but that species is quite different in its yellow medulla and black, glabrous underside (see below).

Fairly plentiful material collected by O. Kühnemann in the *Fitzroya*-forest ("Alerzal") at Lago Menéndez in Chubut.

Type in Herb. Mus. Argent. Cienc. Nat., Buenos Aires; isotypes in Herb. Mus. Nat. Canada, Ottawa, and Herb. A. H. Magnusson, Göteborg.

Nephroma analogicum Nyl. and *N. patagonicum* Kphbr. are placed apart as separate species in Zahlbruckner's *Cat. Lich. Univ.*, Vol. III, 422, 425: 1925, but Zahlbruckner himself, in *Kgl. Svensk. Vet.-Akad. Handl.*, Vol. LVII, no. 6, 20: 1917, pointed out that they are synonymous, an opinion which could be completely confirmed by the present author's examination of the type specimens at Helsingfors and at München. Köfaragó-Gyelnik gave a long description of the type-specimen of *N. patagonicum* in *Ann. Cryptog. Exot.*, Vol. IV, 122: 1931; his statement that rhizinae are present here and there on the underside is erroneous, for in Krempelhuber's specimen the black underside is completely glabrous, as it is also in the Nylander type of *N. analogicum*, as far as can be seen from the scanty, glued-down material. Gyelnik has also redescribed the type of *N. analogicum* (in *Ann. Mus. Nat. Hungar., Pars Bot.*, Vol. XXIX, 9: 1935), and here again his description is partly erroneous. His mention of pubescence on the underside of the thallus is misleading, for he used this term in his *Nephroma*-studies in cases where short projecting hyphae are visible only under the microscope, without any macroscopically visible pubescence. He is also wrong in attributing Nostocoid algal symbionts to *N. analogicum*; in the type-specimen they are clearly protococcoid, pale green, globose, 7–12 μ diam., thin-walled, separable, not in slime-sheaths.

Nephroma (Nephromium) **chubutense** M. Lamb (n. sp.)

Thallus suborbicularis, 5–7 cm. latus, substrato arcte adnatus, sat rigidus et coriaceus, stramineo-flavens, opacus vel subnitidus, in centro isidiis fuscis aut stramineo-fuscis, complanato-squamulosis, numerosissimis, quasi crustam hic illic diffractam formantibus, late et confluenter obsitus. Laciniae ambitu confertae, longit. 0.5–1.0, latit. 0.2–0.4 cm., superficie reticulato-rugosae et marginibus elevatis, crispatis, isidiis fuscis squamulosisque parce aut sat abundanter munitis. Thallus subtus substrato late adhaerens, tantum zona peripherica 3–9 mm. lata visibilis, glaber, griseo-nigrescens, ambitu pallidior (pallide fuscus aut alutaceo-fuscescens), opacus, undulatus, haud distincte bullatus, laevigatus. Medulla partim alba, partim pallide flavescens aut aurantiaco-flavescens. Gonidia Nostochinea, coeruleo-pallescentia aut virescentia, interdum flavidula aut rubescentia, vagina gelatinosa sat crassa induta. (Apothecia ignota.) — Thallus extus KHO– , $CaCl_2O_2$– , PD– , intus KHO– , $CaCl_2O_2$– , PD + leviter testaceo-rubescens. — In sect. *Nephromio* colore stramineo et isidiis fuscescentibus, squamulaeformibus, in parte centrali thalli late confluentibus et quasi crustam formantibus, locum bene distinctum tenet. — Corticola in Argentina, Patagonia, Chubut, ad lacum Menéndez: M. Lamb, 1950, no. 5916.

Thallus ± orbicular, 5–7 cm. diam., closely attached to the substratum (bark), ± rigid and coriaceous, shortly and crowdedly lobate at periphery, in central parts ± covered and concealed by a crust of brown or yellowish-brown, squamulose isidia. Peripheral zone 0.7–1.5 cm. wide, only sparingly isidiate, stramineous-yellow (yellow-brownish or brown at the extreme ends of the lobes), matt or subnitid, the lobes crowded, 0.5–1.0 cm. long, 0.2–0.4 cm. wide, with reticulate-rugose surface and ±

raised, crisped edges garnished more or less abundantly with brown, flattened-squamuliform isidia 0.2–0.4 mm. diam. Central part of thallus ± completely covered with a continuous or irregularly diffract, brown, matt crust of very crowded, squamuliform isidia. Underside free from the substratum only at the periphery, in a zone 3–9 mm. wide; glabrous, pale brown to buff-brown at the edges, gray-blackish further in, matt, irregularly undulate-folded but not distinctly bullate, not wrinkled, matt. Medulla in places white, in other places pale yellow to orange-yellow. Thallus externally KHO– , $CaCl_2O_2$– , PD– ; medulla KHO– , $CaCl_2O_2$– , PD + brick-red (not very intensely). (Sterile.)

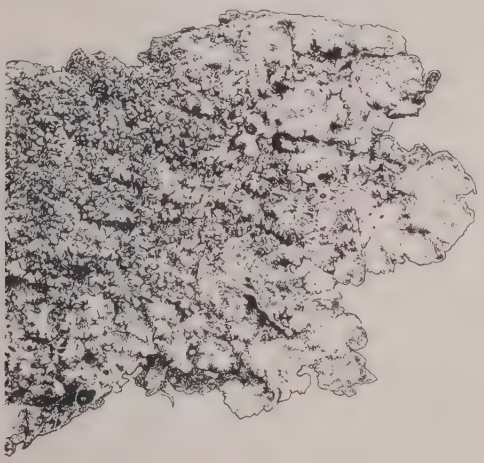


Fig. 11. *Nephroma chubutense* M. Lamb. Part of the type-specimen (× 3).

Thallus 200–275 μ thick where not isidiate, corticate on both surfaces; upper cortex 35–40 μ thick, dull yellowish-inspersed or in places brown, ± opaque except in very thin sections, pseudoparenchymatic, of isodiametric, obtusely angulose cells 3.5–5.0 μ diam. with walls about 1 μ thick; in places covered by a colorless, hyaline, amorphous, gelatinized, necrotic stratum up to 7 μ thick. Algal layer 50–70 μ deep, in ± interrupted nests; algae Nostocoid, pale blue-greenish to yellowish or reddish, in clusters surrounded by distinct hyaline mucilage-sheaths, not distinctly concatenate, round or slightly oblong, 3.5–7.0 μ diam. Medulla grayish-nubilated, of colorless, thin-walled, ± closely entangled hyphae 3 μ thick running in various directions or predominantly horizontally. Lower cortex 14–24 μ thick, pale sordid brownish to dark brown, not or hardly cloudy, but ± obscured by pigment, somewhat indistinctly pseudoparenchymatic, of isodiametric, rounded or obtusely angulose cells 2.5–3.5 μ diam., their walls about 1 μ thick. No rhizinae or tomentum-hyphae present.

As far as the present writer's knowledge goes, there is no other species in the sect. *Nephromium* with distinctly stramineous-yellow color of thallus.

Collected at the west end of the Lago Menéndez on the trunk of a small tree in open scrub formation in the lower reaches of the Torrecillas glacier stream.

Type in Herb. Mus. Nat. Canada, Ottawa.

Nephroma (Nephromium) **lepidophyllum** (Räs.) Gyeln., f. **hypomelaena** Räs. (n.f.)

"Thallus subtus laevigatus, fusconiger vel ad marginem fuscescens" (Räs. *in litt.*). Thallus 3–8 cm. latus, pallide aut obscure fuscus, opacus vel partim subnitidus, irregu-

lariter lobatus, crebre et subtiliter reticulato-costatus et lacunosus, costis isidiis parvis squamulosis munitis et simul saepe excoriatis. Apothecia orbicularia aut reniformia, ad 7 mm. lata, rufofusca, margine thallino pertenui. (Sporae haud evolutae.) — Ad corticem *Nothofagi pumilionis* in Argentina, Patagonia, Río Negro, lacus Frias: M. Lamb, 1950, no. 6010.

Thallus 3–8 cm. diam., pale to dark brown, matt or subnitid, irregularly lobate, closely and finely reticulate-costate and lacunose, the ridges beset with small squamulose isidia and often splitting open to expose the white medulla. Underside brownish-black, brown towards the periphery, glabrous, smooth. Apothecia roundish to kidney-shaped, up to 7 mm. diam., reddish-brown, with very thin thalline margin. (Spores not developed.) Medulla KHO– , $CaCl_2O_2$– , PD– .

The authentic material of *Nephroma lepidophyllum* (Räs.) Gyeln., described from southern Chile (Magallanes and Ñuble) has not been seen by the present author, but Dr. V. Räsänen, to whom a portion of no. 6010 was sent, kindly compared it with the type of the species in his herbarium and stated it to be conspecific but differing in the darker and smooth underside; in the typical species the underside is ochraceous-whitish and ± bullate. There is some resemblance to *N. cellulosum* (Sm.) Ach., but isidia are present and the reticulations of the thallus are finer and closer. *N. venosum* Degel., from the Azores (Degelius in *Göteborgs Kgl. Vetensk.- och Vitterh.-Samh. Handl.*, ser. 6 B, Vol. I, no. 7, 23, Pl. II: 1941) is in many respects similar, but differs in the thin papery thallus, usually more scanty isidia, smaller apothecia, different chemical reactions, etc.

A single small population found in the trunk of a "Lenga" (*Nothofagus pumilio*) alongside the bed of a stream near the Lago Frias by the western end of Lago Nahuel Huapí.

Type in Herb. V. Räsänen (Helsingfors Botanical Institute); isotypes in Herb. Mus. Nat. Canada, Ottawa, and Farlow Herb.

Lecidea (Eulecidea) **patagonica** M. Lamb (n. sp.)

Thallus albus, tenuis, effusus, indistincte et minute areolatus aut partim continuus vel fere membranaceus, passim parcius evolutus et (propter hypothallum cyaneo-nigrescentem) caesioalbescens; ambitu vulgo linea hypothallina tenui nigricanti limitatus. Apothecia numerosa, sparsa, sessilia, rotundata, basi constricta, (0.5–) 0.8–2.0 mm. lata, nigra, nuda, diu sat plana et margine proprio integro vix prominenti cincta, demum depresso-convexa et immarginata. Excipulum extus anguste aeruginoso-obscuratum, intus late hyalinum et cum hypothecio confluens. Hypothecium incoloratum, hyalinum, saltem inferne granulis sordide flavidis parce inspersum. Hymenium 70–95 μ altum, hyalinum, paraphysibus concretis, epithecio obscure aeruginoso aut cyanescenti-fuligineo. Sporae 8nae, ellipsoideae aut elongato-ellipsoideae, simplices, incoloratae, 15–18 × 6–7 (–8) μ, apicibus rotundatae aut obtuse acuminatae, interdum halone mucilaginosa tenui indutae. — Thallus KHO– , $CaCl_2O_2$– , PD– , hyphae medullares I– . Epithecium KHO– , HNO_3 + purpureo-violascens. Hymenium et hypothecium subhymeniale I + coerulescens. — In stirpem *L. lithophilae* prope *L. subdeclinantem* Müll. Arg. locanda, a qua colore excipuli, hymenio altiori et sporis majoribus distinguitur. — Saxicola et lapidicola in Argentina, Patagonia, Río Negro, insula Victoria in lacu Nahuel Huapí: M. Lamb, 1950, no. 5818, et prope lacum Frias: M. Lamb, 1950, no. 6029 (typus speciei).

Description of the type-specimen (*M. Lamb no. 6029*): Thallus forming ill-defined and ± confluent patches 2–5 cm. diam., bounded in most parts of periphery by a thin blackish hypothalline line; thin (not over 0.15 mm. thick), white (or in places sordid ochraceous-conspurcated), partly very thin, continuous and ± membranaceous, interrupted, with the filmy bluish-gray hypothallus visible in between; or partly thicker, contiguous and indistinctly areolate; areolae usually not well defined, minute, 0.2–0.4 (–0.6) mm. diam., plane or only slightly convex, separated by very narrow and often indistinct cracks. Seen with the naked eye, the thallus

appears as a thin whitish film, partly bluish- or greenish-gray (from the hypothallus). Thallus KHO– , $CaCl_2O_2$– , PD– ; medullary hyphae I– . Algae protococcoid, bright green, globose, thin-walled, 7–15 μ diam. Apothecia numerous, irregularly scattered, sessile, slightly to moderately constricted at base, round, (0.5–) 0.8–1.5 (–1.8) mm. diam., entirely black and matt (shining only where rubbed), for a long time plane with moderate but not prominent, entire proper margin, finally becoming moderately convex with the margin excluded. Disc smooth, not papillate or fissured, not pruinose.

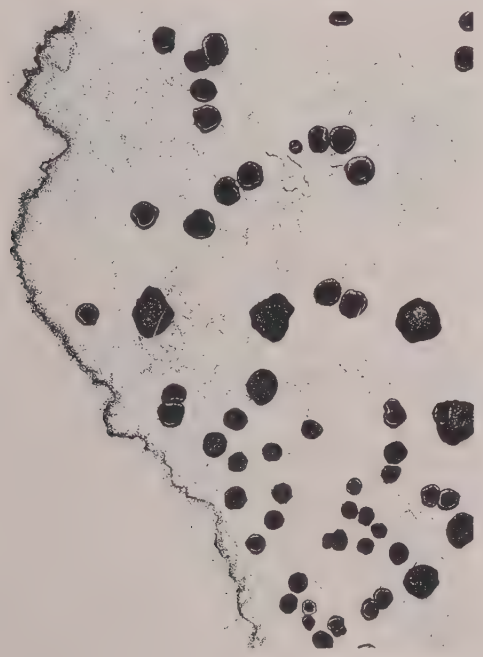


Fig. 12. *Lecidea patagonica* M. Lamb. The type-specimen ($\times$ 4).

Excipulum continued a long way round below apothecium, but not quite reaching to center; 60–100 μ thick, abruptly dark aeruginose or aeruginose-blackish in outermost 7–15 μ, internally colorless and hyaline, with a few scattered sordid yellowish-gray granules; of radiating palisade-structure, with parallel, conglutinated and gelatinized, indistinct, pachydermatic hyphae 4–5 μ thick. Hypothecium merging gradually into excipulum at sides, colorless, up to 260 μ deep, composed of indistinct, gelatinized, densely compacted and intertexted hyphae 1.5–2.0 μ thick, hyaline but with scattered irregular inclusions of $\pm$ granular, sordid yellowish-gray substance (especially in lower part). Hymenium 85–95 μ high, in uppermost 10–17 μ $\pm$ gradually dark aeruginose or aeruginose-blackish, otherwise colorless and hyaline. Paraphyses concrete in mucilage, 1.0–1.5 μ thick, simple or sparingly branched, not articulated, $\pm$ clavate-capitate to 2.5–3.5 μ at the blue-green tips. Asci clavate, 60–85 $\times$ 12–16 μ, with $\pm$ gelatinous wall up to 1.5 μ thick, in immature asci thickened up to 13 μ at the apex. Spores 8, biseriate in ascus, ellipsoid to elongate-ellipsoid, rounded or obtusely pointed at ends, with thin smooth wall, 17–18 $\times$ 6.0–6.5 μ, sometimes invested in a

thin clear refractive mucilaginous coat. Hymenium and upper part of hypothecium I + blue (contents of asci finally vinous-fulvescent); inner colorless part of excipulum I + faint blue. Epithecium and outer part of excipulum KHO– or more olivaceous greenish, HNO_3 + violet-purple.

The other specimen, no. 5818 from the Isla Victoria, agrees well with the holotype, differing only in the following unimportant respects: apothecia up to 2 mm. diam., well constricted at base; excipulum up to 150 μ thick; hypothecium up to 340 μ deep; hymenium 70–90 μ high; paraphyses up to 2 μ thick; spores 15–17 $\times$ 6–7 (–8) μ, without mucilaginous coat.

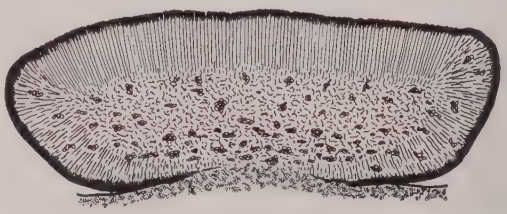


Fig. 13. *Lecidea patagonica* M. Lamb. The type-specimen. Section of an apothecium.

L. patagonica obviously belongs to the *Lecidea lithophila*-group, and is distinguished by the high hymenium and relatively large spores. Other Patagonian species to which it appears to be closely related are *L. subdeclinans* Müll. Arg., *L. lechleri* Zahlbr., *L. xantholeuca* Müll. Arg., and *L. corralensis* Räs. *L. subdeclinans* (see following revision) differs in the entirely darkly pigmented excipulum without colorless internal part, lower hymenium, and somewhat smaller spores. *L. lechleri* (Syn. *L. leucoplaca* Müll. Arg., non Steud.) differs in the quite continuous thallus without bounding hypothallus, the greenish hymenium, and the shorter spores. *L. xantholeuca*, otherwise similar, is distinguished by its yellowish thallus. *L. corralensis* has much smaller apothecia. *L. subauriculata* B. de Lesd., a N. American species, somewhat resembles our plant, but differs in the less developed, differently colored thallus and more broadly ellipsoid spores. *L. hornii* Lynge, from N. E. Greenland, has many characters in common with *L. patagonica*, but its apothecia are smaller and its spores distinctly larger. Among the European species, *L. patagonica* approaches only *L. italica* B. Lesd., which has larger, concave and persistently marginate apothecia.

The type-specimen was found on non-calcareous metamorphic stones beside the pathway through the forest between Lago Frias and the Frias Glacier; the other specimen from the Isla Victoria was growing on dry non-calcareous rocks near the shore of the lake, associated with *Verrucaria aethiobola* Wbg.

Type in Herb. Mus. Nat. Canada, Ottawa.

Lecidea (Eulecidea) **subdeclinans** Müll. Arg.

in *Nuov. Giorn. Bot. Ital.*, Vol. XXI, 45: 1889.

Revision of the type-specimen from Fuegia, Staten Island, Port Cook, coll. Spegazzini, 1888 (no. 68), in Herb. Müll. Arg., Herb. Boissier, Geneva: On apparently metamorphic, ± schistose rock. Thallus well developed, effuse, thickish and tartareous, 0.3–0.6 mm. thick, not areolate but with anastomosing and ± reticulating, ± sharp-edged cracks less than 0.1 mm. wide; ash-gray (in places with a faint ochraceous tinge), smooth or only slightly uneven, or in places indistinctly verruculose, matt. No hypothallus seen (acc. to Müller Arg. the thallus is bounded by a black hypothalline line). Thallus KHO + distinct yellow, $CaCl_2O_2$– , medulla I– under

microscope. The thallus is ecorticate, of compact undifferentiated structure with ± gelatinously fused, indistinct hyphae, grayish-nubilated and oily-grumose in the lower part; uppermost 15–35 μ yellowish as if from the sheaths of blue-green algae: the symbiotic algae are however protococcoid. Apothecia numerous, irregularly dispersed, sometimes several confluent, many of them undeveloped, small and semi-immersed; mature apothecia sessile, slightly to moderately constricted at base, 0.8–1.0 mm. diam., round or ± angulose, black, matt (nitid only where rubbed), persistently plane or finally very slightly convex, naked, with ± persistent, thin and somewhat indistinct, hardly prominent, entire or slightly flexuose, concolorous proper margin.

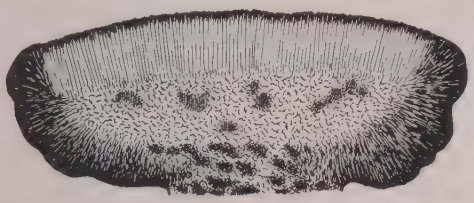


Fig. 14. *Lecidea subdeclinans* Müll. Arg. The type-specimen. Section of an apothecium.

Excipulum developed at sides, where 65–90 μ thick, becoming indistinct at the base below the apothecium; entirely brown or reddish-brown in section from dense pigment between the hyphae, which are parallel, conglutinated, about 3.5 μ thick, with indistinct walls. There is no pale inner excipular stratum as in *L. lapicida* Ach. Hypothecium colorless or in places with irregular patches of brownish pigment, 100–115 μ deep, its base resting on a vague, patchily brownish-pigmented tissue (apparently basal continuation of the excipulum) which runs down slightly into the underlying thallus. In thicker sections the hypothecium appears ± uniformly pale brownish. Hymenium 55–65 μ high, gradually dark brown (no aeruginose tinge) in uppermost 6–10 μ, otherwise colorless or towards the base slightly brownish-cloudy. Paraphyses concrete in mucilage, 1.0–1.5 μ thick, at the tips capitate up to 3.5 (–5.0) μ and there ± brown-pigmented. Asci 45–55 × 12–15 μ. Spores ellipsoid to elongate-ellipsoid, with thin smooth wall, not halonate, 13.5–16.0 × 5–6 μ. With KHO, a yellow mist flows from sections of thallus and apothecia; the excipulum becomes lighter reddish-brown, the hypothecium ± entirely colorless, the epithecium lighter and more olivaceous brownish. With Iodine, hymenium blue then dark greenish-blue; hypothecium and excipulum I– .

Müller Arg., *loc. cit.*, also published a β *steriza* Müll. Arg. of the species from the same locality, distinguished by the obsolete thallus. In his herbarium there are two specimens bearing this name, both from Staten Island, Port Cook, collected by Spegazzini in 1888, nos. 62 and 63 respectively. Number 63 is obviously referable to *Lecidea lapicida* Ach. (var. *ecrustacea* (Bausch.) Anzi), having the thickly margined apothecia and internal structure characteristic of that species; the other specimen, no. 62, is different and is apparently conspecific with *L. subdeclinans* Müll. Arg., differing chiefly in the obsolete thallus, which is represented only by a few indistinct, sordid whitish traces around and below the apothecia. This specimen, no. 62 of Spegazzini's collection, is therefore proposed as the lectotype of the var. *steriza* Müll. Arg. In addition to the obsolete thallus, it differs slightly from the holotype of the typical *L. subdeclinans* in the dark aeruginose or aeruginose-blackish (not brown) color of the outer excipulum and the epithecium, and in slightly smaller spores (12–14 × 5 μ), both of these probably normal variations.

Certainly belonging to the *Lecidea lithophila*-group, and coming nearest to *L. subplanata* Vain., from which it differs chiefly in the longer spores.

Lecidea (Psora) **hypotheja** M. Lamb (n. sp.)

Thallus congesto-squamulosus, caespites latos, crassos, deplanato-pulvinatos efficiens, squamulis confertis, imbricatis, erectis aut varie intricatis, 1.0–2.5 (–4.0) mm. longis et latis, ambitu rotundatis aut sinuato-lobatis, planis aut concavis, superne fusco-alutaceis, laevigatis, opacis, nudis, ad peripheriam anguste sulphureo-flavescentibus, ibique sat tumidis et nonnihil pulverulentis; inferne laete sulphureis, subtilissime radiatim adpresso-fibrosis (haud rhizinosis), opacis. Apothecia satis numerosa, squamulis superficialiter et marginaliter insidentia, ab initio subglobosa et omnino immarginata, fuscorufescentia, aetate fusconigrescentia, basi constricta, laevigata, nitidiuscula, ad 1.3 mm. lata, dein saepe proliferantia et acervulos ad 2.5 (–3.0) mm. latos formantia. Excipulum (amphithallinum) superne rufofuscescens, basin versus sensim hyalinum. Hymenium cum hypothecio rufo- aut purpureo-fuscescens, in summa parte intensius ita tinctum, 60–80 μ altum; hypothecium 50–70 μ crassum, strato myelohyphico (cono centrali) crystalligeno et partim flavovirescenti superpositum. Paraphyses concretae, indistinctae. Asci clavati (sporis haud evolutis). — Thallus extus intusque KHO– , $CaCl_2O_2$– , PD– ; hyphae medullares I– . Hymenium I + partim sordide aeruginascens, in KHO (cum hypothecio) solutionem violaceo-rubricosam effundens. — Pulchra et insignis species, affinis ut videtur *L. ictericae* (Mont.) Tayl., squamulis adscendentibus, intricato-congestis, caespites pulvinatos formantibus dignota. — In fissuris rupium praeter litora lacustria in Argentina, Patagonia, Chubut, prope Futalaufquen: M. Lamb, 1950, nos. 5870 (typus speciei), 5932.

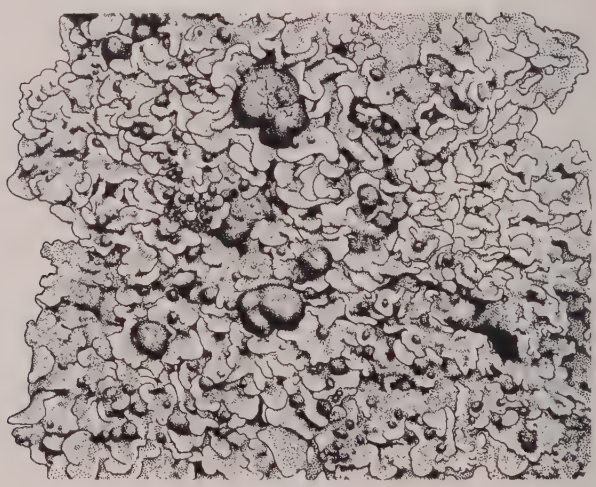


Fig. 15. *Lecidea hypotheja* M. Lamb. Part of the type-specimen (× 3).

Description of the type-specimen (*M. Lamb no. 5870*): thallus congested-squamulose, forming compact, flattened-pulvinate patches 5–10 cm. diam. and 1.0–1.5 cm. thick; squamules crowded, imbricated, upright to ± horizontal, 1.0–2.5 (–4.0) mm. long and broad, about 0.15 mm. thick, rounded or ± sinuate-lobed, plane or concave, alutaceous or pale brown on upper side, with finally ± tumid, yellow, often slightly pulverulent (but not sorediate) margins. Upper side smooth, matt, not pruinose. Lower side of squamules sulphur-yellow, subtly radiately adpressed-fibrose but not rhizinose, matt. No isidia or soredia. Squamules externally and internally KHO– ,

$CaCl_2O_2$– , PD– ; medulla I– . Apothecia fairly numerous, on upper side of squamules, both marginal and superficial, subglobose and completely immarginate from the first, reddish-brown, finally becoming brown-blackish, well constricted at base, simple or the larger ones becoming sulcate and ± completely divided into aggregations of pulvinate secondary discs; smooth, moderately nitidous; simple apothecia up to 1.3 mm. diam., compound apothecia up to 2.5 (–3.0) mm. diam. and often sharply fissured.

Upper side of squamules corticate with a colorless, hyaline cortex 70–120 μ thick composed of gelatinized, thick-walled hyphae intricated in various directions, only the lumina, 2–3 μ wide, visible in the clear gelatinous matrix. Upper side of cortex somewhat irregular; lower side sharply delimited from the algal stratum. Algal stratum continuous, 60–90 (–100) μ deep, somewhat diffuse on lower side. Medulla 120–200 μ thick, hyphose, sordid yellowish- or greenish-yellowish-cloudy in section (but without visible granules), composed of thin-walled hyphae 3–4 μ thick completely intricated in various directions or partly predominantly ± horizontal, without noticeable air-spaces. No lower cortex developed; underside of squamules formed by the medullary tissue, with the hyphae somewhat larger (up to 4.5 μ diam.) and thicker-walled (walls up to 1.5 μ thick), more loosely intertexted; no visible granules. The medulla becomes ± clear and hyaline with KHO, without mist; sections $CaCl_2O_2$– , I– . Symbiotic algae protococcoid, bright green, globose, 6–10 μ diam., thin-walled. The yellow color of the underside and edges of the squamules is due to the sordid yellowish nubilation of the medullary layer.

Excipulum of amphithecial origin, merging gradually into the thallus cortex below and into the hymenium above, in upper part yellow-brownish or red-brownish, in lower part becoming colorless and hyaline; composed of conglutinated and gelatinized, thick-walled, parallel-radiate hyphae, the lumina distinct, 1.5–2.0 μ wide. Central cone compact, filled with irregular colorless crystals up to 10 μ diam. and a ± amorphous, yellow-greenish substance; the intertexted hyphae colorless, indistinct. Hypothecium 50–70 μ deep, reddish-brown (concolorous with the hymenium), composed of compactly intricated hyphae 2–3 μ thick with thin, ± pigmented walls. Hymenium 70–80 μ high, entirely reddish-brown, darker reddish-brown in uppermost 9–14 μ. Paraphyses concrete, indistinct in water, in KHO ± discrete, about 2 μ thick, embedded in turgescent mucilage, simple or occasionally branched, not articulated, not noticeably thickened at tips. Asci clavate, immature, 45–50 × 10 μ. (No spores developed.) Both hymenium and hypothecium give off a crimson-purple solution with KHO.

In both the specimens the hymenium is completely destitute of spores, although the apothecia are otherwise well developed. The only other species of sect. *Psora* which at all resembles it is *L. icterica* (Mont.) Tayl., which has similarly yellow-edged squamules of about the same color, but these in *icterica* are all closely applanate to the substratum, not ascendant.

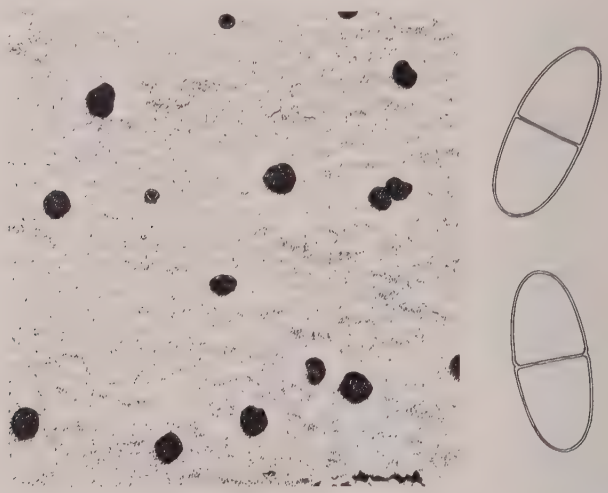
L. hypotheja was locally abundant in both the localities, Lago Verde and Lago Cisnes, some miles apart, forming clumps and patches on detritus in crevices of steep rocks by the shores of the lakes, 1 to 1.5 m. above the water level.

Type in Herb. Mus. Nat. Canada, Ottawa; isotypes in Farlow Herb., Herb. Inst. Syst. Bot. Uppsala, and Herb. Inst. Bot. Darwinion, San Isidro, Buenos Aires.

Catillaria melanopotamica M. Lamb (n. sp.)

Thallus sat late effusus, saepe ambitu hypothallo tenui, viridinigrescenti aut obscure cinereo limitatus, albidus, opacus, tenuis, continuus aut partim minute reticulato-rimosus (haud rite areolatus), sat laevigatus aut minute granuloso-inaequalis. Apothecia copiosa, sparsa, sessilia, ad basin modice constricta, rotundata, 0.6–1.0 mm. lata, ab initio nigra, plana aut demum convexa, primitus margine proprio concolori, opaco vel nonnihil nitido, mediocri, integro, satis prominenti cincta, deinque immarginata. Excipulum integrum, ad marginem irregulariter purpureo-tinctum, cae-

terum incoloratum; e hyphis radiantibus, pachydermaticis, conglutinatis constans. Hypothecium totum hyalinum (incolor aut leviter sordide lutescens) aut superne leviter purpureo-fuscescens. Hymenium 100–125 μ altum, pallide purpureo-violascens, epithecio purpureo-fuligineo; paraphysibus discretis, apicibus capitatis. Sporae 6–8nae, subbiseriatae, ellipsoideae, 1-septatae, incolores, 18–23 $\times$ 8.5–10.0 μ. — Thallus KHO + lutescens, $CaCl_2O_2$– , PD– aut indistincte flavescens; hymenium I + coerulescens deinque sordide aeruginascens, KHO (cum parte marginali excipuli) + purpureo-rubescens. — *C. superfluae* (Müll. Arg.) Zahlbr. e Australia arcte relata, excipulo marginali purpurascenti, hymenio altiori et purpureo-violascenti, epithecio purpureo-fuligineo, sporis angustioribus, aliisque notis diversa. — Ad corticem *Nothofagi* in Argentina, Patagonia, Río Negro, insula Victoria in lacu Nahuel Huapí: M. Lamb, 1950, nos. 5815 (typus speciei), 5836.



Figs. 16 & 17. *Catillaria melanopotamica* M. Lamb. Part of the type-specimen ($\times$ 4); spores ($\times$ 1250).

Description of the type-specimen (M. Lamb no. 5815): thallus effuse, forming patches 5–10 cm. diam. on the smooth bark, bounded at most places of periphery by a thin, non-fimbriate, greenish-black or dark gray hypothallus, which is also visible here and there in the thinner parts of the central thallus. Thallus whitish or cream-colored, matt, thin (up to 0.2 mm. thick), continuous or in most places minutely reticulate-rimose (not areolate), ± smooth or usually minutely granulose-uneven, KHO + yellow, $CaCl_2O_2$– , PD + (slowly) faint yellowish. Apothecia numerous, evenly scattered, sessile, moderately constricted at base, discoid, 0.6–1.0 mm. diam., entirely black at all stages of development, plane to slightly convex, not pruinose, with matt, smooth or minutely scabrid disc; proper margin black, matt or subnitid, moderate, entire, at first somewhat prominent, finally becoming reflexed and disappearing. Symbiotic algae of thallus protococcoid, pale green, globose, 6–9 μ diam., thin-walled.

Excipulum entire below apothecium, 65–78 μ thick, at the margin up to 100 μ thick; composed of conglutinated, radially parallel, thick-walled, gelatinous hyphae, with only the fistulose lumina (about 1 μ wide) distinctly visible; in the basal part colorless and hyaline, in the margin unevenly purplish from amorphous pigment between the

hyphae. Hypothecium 100–135 μ deep, either entirely colorless and hyaline, or in the upper subhymenial 20–30 μ very faintly and unevenly purple-brownish; composed of densely compacted, thin-walled hyphae 2–3 μ diam. intricated in various directions. Hymenium 100–125 μ high, pale purplish-violascent from vertical purplish streaks between the paraphyses; the epithecium up to 17 μ thick, irregular, purple-blackish. Paraphyses discrete in water, 1.5–2.0 μ thick, at the tips capitate to 5 μ and there coated with amorphous, purple-blackish pigment; simple or sparingly branched, not anastomosing. Asci clavate, 75–85 μ long, 15–18 μ wide, with wall about 1.5 μ thick at sides, at the apex spuriously gelatinously thickened up to 25 μ. Spores 7–8 in ascus, irregularly biseriate; ellipsoid, 1-septate, occasionally very slightly constricted at the septum, with wall and septum of equal thickness (about 1 μ); plasm clear and hyaline; 18–23 × 8.5–10.0 μ. With KHO added to sections of apothecium, the hymenium and colored lateral parts of excipulum turn purple-red; the hypothecium and colorless lower excipulum + slight yellow. Hymenium I + blue then sordid dark aeruginose, other parts I– .

The other specimen, no. 5836, collected some distance away in the Isla Victoria, agrees well with the holotype; the only differences of note are the following: hypothallus often indistinct. Thallus PD– . Apothecia finally well convex and immarginate. Hypothecium colorless or entirely faintly lutescent in section, the upper subhymenial part more grumose-inspersed but not purple-brownish. Asci up to 100 μ long (but height of hymenium the same). Spores 6–8 in ascus; wall and septum up to 1.5 μ thick.

The species comes closest to the Australian *C. superflua* (Müll. Arg.) Zahlbr., and could not be distinguished with certainty from the latter on the basis of the diagnosis alone. Müller Arg.'s type specimen was therefore examined (see revision below), and the following differences, which seem to be specific, were found:

C. melanopotamica	*C. superflua*
Marginal part of excipulum purplish or purple-reddish.	Marginal part of excipulum dark olivaceous, greenish-brown, sordid aeruginose or fuliginous.
Hypothecium entirely colorless or faintly lutescent, occasionally very faintly purple-brownish in upper part.	Hypothecium colorless and hyaline in lower part, in upper part pale sordid olivaceous or olivaceous-isabelline.
Hymenium 100–125 μ high, entirely pale purplish-violascent from streaks of pigment between the paraphyses.	Hymenium 85–100 μ high, entirely colorless and hyaline except for the epithecium.
Epithecium purple-blackish (KHO + purple-reddish).	Epithecium aeruginose-blackish (KHO + dark sordid brown).
Spores 8.5–10.0 μ broad.	Spores 10–12 μ broad.

C. melanopotamica is probably also related to the Australian *C. frenchiana* (Müll. Arg.) Zahlbr., but differs from the latter in different color of thallus, smaller spores, etc.

Both specimens seen were on trunks of "Coihue" (*Nothofagus dombeyi*).

Type in Herb. Mus. Nat. Canada, Ottawa; isotypes in Farlow Herb. and Herb. Inst. Bot. Darwinion, San Isidro, Buenos Aires.

Catillaria phaeolomiza M. Lamb (n. sp.)

Thallus effusus, tenuis, albicans, inaequalis aut verruculoso-inaequalis (praesertim e asperitate substrati), opacus, continuus aut indistincte et minute reticulato-rimosus (haud rite areolatus), hypothallo haud bene visibili. Apothecia numerosa, sparsa, sessilia, rotundata, 0.5–0.8 mm. lata, basi leviter aut modice constricta, nigra aut saepe partim pallidiora (fusconigrescentia), plana et margine mediocri, parum prominenti,

integro, concolori circumdata, dein leviter convexa et immarginata. Excipulum integrum, ad basin incoloratum, in margine striatim purpureo-rubescens aut fere hyalinum, e hyphis radiantibus et conglutinatis formatum. Hypothecium inferne hyalinum, superne irregulariter obscure fuscescens aut purpureo-fuscescens. Hymenium 95–120 μ altum, hyalinum, epithecio olivaceo-fuligineo, paraphysibus discretis, apicibus capitatis et subaeruginosis aut fuligineis. Sporae 8nae, biseriatae, ellipsoideae, incolores, 1-septatae, 18–25 $\times$ 8.5–10.0 μ. — Thallus KHO + lutescens, $CaCl_2O_2$– , PD– ; hymenium I + coerulescens deinque aeruginascens; hypothecium superius (cum excipulo marginali) KHO + purpurascens; epithecium KHO + olivaceo-fuscescens. — Affinis praecedenti (*C. melanopotamicae*), at hypothecio superne fusco, hymenio hyalino, epithecio aliter colorato et KHO haud purpurascenti, et apotheciis saepe pallidioribus distincta videtur. Ad *C. phaeolomam* (Kn.) Zahlbr. e Australia, hucusque tantum e descript. cognitam, arcte accedere possit. — Corticola in Argentina, Patagonia, Nahuel Huapí, loco accuratius non indicato: L. E. Cannelle, 1943, no. 120.

Thallus effuse, thin, 0.1–0.2 mm. thick, cream-colored or whitish, uneven or verruculose-uneven (largely from the inequalities of the substratum), matt, continuous or indistinctly and minutely reticulate-rimose, not areolate. No dark hypothallus seen. Thallus KHO + yellow, $CaCl_2O_2$– , PD– . Apothecia numerous, ± evenly scattered, 0.5–0.8 mm. diam., discoid, sessile, slightly to moderately constricted at base, black or occasionally partly paler (brown-blackish), at first plane with moderate but hardly prominent, entire, black or brownish margin, then becoming slightly convex and immarginate. Disc matt, black or rarely partly brownish, smooth or minutely scabrid, not pruinose. Symbiotic algae of thallus protococcoid, globose, separable, 7–14 μ diam., pale green, thin-walled.

Excipulum entire below, up to 85 μ thick below and at sides, at the base colorless, at the sides colorless or streaked with purple-reddish pigment between the hyphae, becoming ⊥ purpurascent on the inner side against the hypothecium; of palisade-structure, with conglutinated, gelatinized, parallel, thick-walled hyphae, the fistulose lumina about 1 μ wide. In a few places on the outer side of the excipulum there may be a faint aeruginose pigmentation in patches. Hypothecium consisting of two parts: (*a*) a lower 35–68 μ, clear and colorless (or in places faintly purplish in its lower half) of indistinctly pseudoparenchymatic structure, without inclusions; and (*b*) an upper 40–57 μ, somewhat patchily dark brown or dark purplish-brown. Total depth of hypothecium is 100–130 μ. Hymenium 95–120 μ high, hyaline, without any purple color, the epithecium irregular, sordid olivaceous-blackish, without any purplish tinge. Paraphyses discrete in water, about 1.5 μ thick, clavate-capitate up to 4 μ at tips and there sordid aeruginose to olivaceous-blackish. Asci 78–95 μ long. Spores 8, biseriate in ascus, ellipsoid, 1-septate, with equally thickened wall and septum (about 1 μ), 18–25 $\times$ 8.5–10.0 μ. With KHO added to sections of apothecium, lower colorless hypothecium and colorless parts of excipulum turn yellow; upper dark hypothecium and colored parts of excipulum turn purpurascent; epithecium KHO + dark olive-brown (not purpurascent). Hymenium I + blue then blue-green; other tissues of apothecium I– .

Comes very close to the foregoing (*C. melanopotamica*), but differs in the distinct dark brown or purplish-brown pigmentation of the upper hypothecium, lack of streaky purpurascent color in the hymenium, olivaceous-blackish epithecium not purpurascent with KHO, and the somewhat paler, not pure black apothecia. There seems to be a considerable resemblance to the Australian species *C. phaeoloma* (Kn.) Zahlbr. and *C. melaloma* (Kn.) Zahlbr., both described in *Trans. Linn. Soc. Lond., ser. 2, Bot.*, Vol. II, 45: 1882, sub *Lecidea*, as far as can be judged from Knight's inadequate descriptions. Unfortunately all attempts to obtain reliably authenticated original material of these two species for comparison were unsuccessful. No specimens could be found in Herb. Kew; in Herb. Nylander, Helsinki, there is a specimen (no. 20934 in Herb. Nyl.) sent by Knight under the name "*Biatora melaloma*," but on examination it proved to be a *Buellia*.

Type in Herb. Crypt. Inst. Miguel Lillo, Tucumán, Argentina, under no. 8618.

Catillaria lacarensis M. Lamb (n. sp.)

Thallus sat late effusus, tenuis, crassit. vix 0.2 mm., partim membranaceus, partim plus minusve desquamescens; albidus, opacus, continuous aut obsolete et subtiliter rimulosus (haud areolatus), laevigatus aut sat inaequalis, haud distincte granulosus, hypothallo haud viso. Apothecia copiosa, sparsa, sessilia, rotundata, basi modice vel bene constricta, 0.6–1.8 (–2.0) mm. lata, nigra, diu plana et margine tenui aut mediocri, integro, satis prominenti praedita, dein paullo convexa, margine evanescenti. Excipulum integrum, lateribus extus aeruginoso-fuligineum, intus rubro- vel purpureo-fuscescens, in parte basali striatim aeruginoso-fuligineum; e hyphis radiantibus et conglutinatis contextum. Hypothecium inferne levissime purpureo-fuscescens aut fere incoloratum (partim sordide flavescenti-granulosum), superne obscure rufofuscescens aut purpureo-fuligineum. Hymenium 100–135 μ altum, sat hyalinum, epithecio fuligineo, paraphysibus discretis, apicibus capitatis. Sporae 6–8nae, subbiseriatae, incoloratae, ellipsoideae, 1-septatae, 24–32 $\times$ 10–13 μ. — Thallus KHO + indistincte (fusco-) flavescens, $CaCl_2O_2$– , PD– ; hymenium I + coerulescens deinque aeruginascens:

Fig. 18. *Catillaria lacarensis* M. Lamb. Part of the type-specimen ($\times$ 4).

hypothecium KHO + rubro-purpurascens; epithecium KHO + purpureo-fuligineum. — A *C. phaeolomiza*, quacum habitu externo et hypothecio superne fusco congruit, distat excipulo partim aeruginoso-fuligineo (nec purpureo-fuscescenti), hypothecio inferne granuloso-insperso, et sporis distincte majoribus. — Corticola in Argentina, Patagonia, Neuquén, ad lacum Lacar prope flumen Hua-Hum: O. Kühnemann, 1943, no. 780.

Thallus effuse, forming patches 5 cm. or more in diameter on smooth bark; thin, up to 0.2 mm. in thickness, in places membranaceous, in other places thicker and

desquamescent; cream-colored or whitish, matt, continuous or obsoletely finely rimulose (not areolate), smooth or ± uneven but not distinctly verruculose; KHO + brownish or ferruginous-yellowish, $CaCl_2O_2$– , PD– . No dark hypothallus seen. Symbiotic algae pale green, consisting of thin-walled, globose cells 5–10 μ diam. cohering in clumps and seemingly concatenate, probably *Trentepohlia*. Apothecia numerous, ± evenly scattered, sessile, moderately to well constricted at base, discoid, unequal in size, 0.6–1.8 (–2.0) mm. diam., entirely black, for a long time plane with thin to moderate, entire, moderately prominent, matt or subnitid proper margin, then becoming slightly convex with the margin indistinct or evanescent. Disc matt, smooth or minutely scabrid, not pruinose.

Excipulum entire below apothecium, 50–75 μ thick at sides, up to 100 (–135) μ thick at base, at the sides aeruginose-blackish from amorphous pigment between the hyphae, grading into reddish- or purplish-brown on the inside; at the base ± colorless and hyaline, with scattered streaks of aeruginose-blackish pigment, or sometimes ± evenly aeruginose-blackish. It is composed of parallel, conglutinated, gelatinized, thick-walled hyphae about 5 μ thick, the fistulose lumina about 1 μ wide. Hypothecium 135–200 μ deep, in two distinct parts: (*a*) a lower, faintly purple-reddish or purple-brownish (or almost colorless) 75–120 μ; in its lower part this layer is ± densely packed with yellowish-gray granules; and (*b*) an upper, dark reddish-brown or purple-blackish layer 65–85 μ thick. Hymenium 100–135 μ high, colorless or in places faintly reddish- or purplish-brown, clear; epithecium irregular, fuliginous (not distinctly aeruginose or purplish). Paraphyses discrete in water, filiform, ± sinuous, sometimes branched but not anastomosing, 1–2 μ thick, at the tips slightly clubbed, up to 3.5 μ, and there overlaid with dense amorphous pigment. Spores 6–8 in ascus, subbiseriate; colorless, ellipsoid, 1-septate, with distinct wall and septum of equal thickness, about 1.3 μ; 24–32 × 10–13 μ. The lower unpigmented part of the hypothecium consists of densely packed, thick-walled hyphae 3–5 μ thick intricated in various directions; the upper pigmented part of somewhat thinner intricated hyphae, about 3 μ thick, much obscured by the dark purplish pigment. With KHO added to sections of apothecium, the colored parts of the excipulum become more olive-greenish; hymenium and upper and lower hypothecium become reddish-purpurascent; the epithecium turns purplish-fuliginous. With Iodine, hymenium blue then sordid dark olivaceous-aeruginose; other tissues I .

It is difficult to identify with certainty the nature of the symbiotic algae, but probably they are *Trentepohlia*-filaments in a broken-up condition, as they often occur when enclosed in a lichen thallus. Accordingly this species would by some lichenologists be placed in the genus *Catinaria*, which has been placed by Zahlbruckner in the family Lecanactidaceae. Such a generic distinction, based on the nature of the algal symbionts, is purely artificial and quite untenable.

Type in Herb. Admin. Parques Nacionales, Avda. Santa Fe 690, Buenos Aires; isotype in Farlow Herb.

Catillaria superflua (Müll. Arg.) Zahlbr.

Cat. Lich. Univ., Vol. IV, 75: 1926. Syn. *Patellaria* (*Catillaria*) *superflua* Müll. Arg. in *Flora*, Vol. LXX, 336: 1887.

Revision of the type-specimen from Australia, New England (*New South Wales*), *Walcha, coll. Crawford* (*no. 14*), *in Herb. Müll. Arg., Herb. Boissier, Geneva*: On smooth cracky bark. Thallus effuse, not limited by any hypothallus, apparently extensive and widespread, now sordid subochraceous-whitish (white in fresh condition, acc. to Müll. Arg.), very thin, about 0.05 mm. thick, membranaceous, continuous or with only accidental cracks, smooth or rugulose (following the inequalities of the substratum), matt, not pruinose or scurfy, KHO + yellow or sordid yellow, $CaCl_2O_2$– , PD– . Apothecia numerous, scattered, sessile, round, moderately to well constricted at base, entirely black, 0.5–0.9 mm. diam., at first plane with a moderate, prominent, entire, black, matt or subnitid margin, then becoming slightly to moderately convex with the margin reflexed and invisible. Disc smooth, matt, naked.

Excipulum well developed at sides and continued for some distance round on underside of apothecium, where it becomes gradually indistinct, absent in the center; 60–85 μ thick, of distinctly radiating structure, in the upper marginal part streakily and irregularly pigmented with a dark olivaceous, greenish-brown, sordid aeruginose or fuliginous pigment between the hyphae, which are parallel, partly colorless, gelatinized and conglutinated, thick-walled, 3–5 μ thick (lumina about 1 μ wide). Pigment in KHO becoming fulvous-brown or purplish-brown, in HNO_3 distinctly purple. In the lower part of the excipulum the pigmentation is ± absent. Hypothecium clearly divided into two parts: (*a*) an upper, pale sordid olivaceous or olivaceous-isabelline 60–75 μ of distinct, rather thick-walled, variously intricated or partly vertical hyphae 3.0–4.5 μ thick, and (*b*) a lower, colorless and hyaline layer 65–125 μ deep of more subtle structure, consisting of fine, thin-walled, gelatinously conglutinated hyphae 1.5–2.5 μ thick compactly intricated in various directions; the boundary between the two layers ± sharp and distinct. Hymenium 85–100 μ high, densely and ± abruptly aeruginose-blackish or fuliginous in uppermost 9–14 μ, otherwise colorless and hyaline. Epithecium in KHO loses its aeruginose tinge and becomes dark sordid brown; HNO_3 + dark purple. Paraphyses involved in hyaline mucilage but ± discrete under pressure in water, 1.2–2.0 μ thick, at the tips clavate-capitate up to 3.5–4.5 μ and there overlaid and obscured with dense aeruginose-blackish pigment; simple or sparingly branched, not articulated. Asci clavate, finally (when filled with mature spores) broadly clavate, 75–88 μ long, 14–30 μ broad, with wall 1.2–1.5 μ thick at sides, at the apex gelatinously thickened to 9–12 μ. Spores 8, 2–3-seriate in ascus, colorless, ellipsoid, 1-septate, not constricted at septum, with septum and spore-wall of equal thickness, 1.0–1.3 μ; 20–24 × 10–12 μ (acc. to Müller Arg., 13–32 × 8–10 μ). Hymenium I + persistent dark blue. The upper, pale sordid olivaceous-isabelline part of the hypothecium becomes ± fulvescent with KHO.

Thallus up to 80 μ thick, ecorticate. Symbiotic algae protococcoid, yellow-green, ± globose, 4–9 μ diam.

The three *Catillariae* here described as *C. melanopotamica*, *C. phaeolomiza* and *C. lacarensis* form a closely related complex, possibly a single variable species, but until further collections allow the variability to be studied, it seems best to describe the three rather widely divergent anatomical types as separate species. They may be provisionally distinguished by the following key:

1. Spores 24–32 × 10–13 μ; excipulum aeruginose-blackish at sides and partly below; yellowish-gray granular inclusions present in lower part of hypothecium ..... *C. lacarensis*

1a. Spores smaller, 18–25 × 8.5–10.0 μ; excipulum purplish or purple-reddish at sides, colorless below; no granular inclusions in hypothecium ..... 2.

2. Hymenium pale purplish-violascent (streaks of pigment between the paraphyses); upper part of hypothecium colorless or only faintly purple-brownish ..... *C. melanopotamica*

2a. Hymenium colorless and hyaline; upper part of hypothecium dark brown or purplish-brown ..... *C. phaeolomiza*

Bacidia (Scoliciosporum) **spirospora** Knight

in *Trans. & Proc. New Zealand Inst.*, Vol. XII, 371: 1880.

As lectotype has been selected a specimen in Herb. Nylander (no. 17565) from New Zealand, exact locality and date not stated, coll. C. Knight, sent by Knight to Nylander as "*Lecidea* (*Bacidia*) *spirospora*, Kn." The following is a description of this specimen:

On smooth bark. Thallus in interrupted patches, bounded by blackish hypothallus only at point of contact with other crustaceous lichens, effuse, becoming thin and

membranaceous at the margin, thin, up to 0.2 mm. thick, now whitish with a faint ochraceous tinge (cinerascent in fresh condition, acc. to Knight's description), matt, smooth, irregularly finely rimose, not areolate, KHO– or slightly brownish, $CaCl_2O_2$– , PD– . Apothecia numerous, scattered, adpressed-sessile, round, 0.4–0.7 mm. diam., moderately to well constricted at base, at first plane with a thin, entire, not or only slightly prominent, pale reddish-brown to black margin, then becoming finally slightly convex and immarginate. Disc brown-blackish to black (or occasionally fuscous in younger apothecia), matt, smooth, not pruinose.

Excipulum ± entire below apothecium, or becoming indistinct in the central part below; 55–85 μ thick, either entirely faintly sordid yellowish or isabelline, or gradually pale brown in the outer half, clear, without granules, composed of gelatinously conglutinated, thick-walled hyphae in flabellate-radiate formation, only the lumina visible, these 1–2 μ wide, simple or branched. Hypothecium consisting of two parts: (*a*) a lower, colorless and hyaline half composed of fine conglutinated hyphae about 1.5 μ thick compactly intricated in various directions or at the sides mainly horizontally parallel; and (*b*) an upper, faintly sordid isabelline half, not transparent, but without visible granules, composed of thick-walled, gelatinously concrete hyphae 3–5 μ thick closely intricated in various directions, in the upper subhymenial part going over into finer, ± vertically parallel hyphae about 1.5 μ thick. Hymenium 60–70 μ high, gradually or ± abruptly subaeruginose-fuliginous or indeterminately blackish (not pure aeruginose) in uppermost 8–10 μ, otherwise colorless and hyaline, not inspersed. Paraphyses discrete, 1.0–1.5 μ thick, simple or branched, not anastomosing, not articulated, at tips gradually thickened to 2–3 μ and there ± pigmented, dark sordid subaeruginose. Asci clavate, 50–62 × 12–15 μ, with wall about 1 μ thick at sides, at apex thickened in immature asci to 6–10 μ. Spores 6–8 in ascus, packed parallel in a bundle, not noticeably spirally twisted; outside asci ± straight or slightly flexuose or often sigmoid-flexuose, obtusely pointed at one end, gradually tapering and acuminate at the other, 8–15-septate with rectangular or ± cubical loculi, 45–65 × 3–4 μ. Hymenium I + persistent blue. Sections of apothecium KHO– in all parts; epithecium HNO_3 + bluish-violet.

Fig. 19. *Bacidia spirospora* Knight. The lectotype-specimen. Spores (× 800).

Another specimen, no. 17568 in Herb. Nylander, from New Zealand, coll. Knight, 1867, no. 103, written up by Nylander as "*Lecidea deflexa* Nyl.," is on lignum, and has no distinct thallus, only a patchy whitish discoloration of the lignum. Apothecia entirely black, mostly slightly convex and immarginate, 0.4–0.7 (–1.0) mm. diam.; the hymenium slightly higher than in the lectotype of *B. spirospora*, 65–80 μ, subaeruginose-fuliginous or indeterminately blackish in its upper part. Spores about 68 × 3 μ, usually sigmoid-flexuose, about 15-septate. It is obviously referable to *B. spirospora*, being a lignicolous, ± athalline condition. But another specimen, on bark,

Herb. Nyl. no. 17566, coll. Knight, 1867, no. 302, called "*Lecidea deflexa* (corticola)" by Nylander, is a different species, very similar in the structure of the apothecia, but with different spores, cylindric-fusiform, straight or slightly curved, not flexuose or sigmoid, ± equally rounded at both ends, shorter, 30–43 × 3–4 μ, 7–13-septate: It belongs to the sect. *Eubacidia*.

"*Lecidea deflexa*" Nyl. in *Lich. Nov. Zeland.*, 100: 1888, is obviously an illegitimate synonym for *Bacidia spirospora* Knight, based on the material sent by Knight under the latter name. The species is somewhat similar to the Portuguese *B. acerinoides* Stnr. (in *Oesterr. Bot. Zeitschr.*, Vol. LXVII, 278: 1918), but differs in the color of the epithecium, which in *acerinoides* is colorless to yellow-brown, olivaceous, dark brown or purplish-brown, not aeruginose-fuliginous; also in Steiner's species the hypothecium and excipulum stain more or less violet-purple with KHO. *B. spirospora* also approaches the N. American species *Bacidia idahoënsis* H. Magn. (in *Medd. Göteborgs Bot. Trädg.*, Vol. XIX, 45: 1952, described as belonging to sect. *Eubacidia*, but from the description apparently referable to sect. *Scoliciosporum*), but differs in the thicker hypothecium, ± distinctly divided into two parts and KHO– , the negative reaction of the epithecium with KHO, and the smoother thallus of different color.

Var. **patagonica** M. Lamb (n. var.)

Similis speciei typicae, solummodo apotheciis nonnihil majoribus (usque 1 mm. latis), hymenio altiori (75–100 μ) et epithecio magis aeruginoso differens. — Corticola in Argentina, Patagonia, Chubut, prope lacum Menéndez: M. Lamb, 1950, no. 5933.

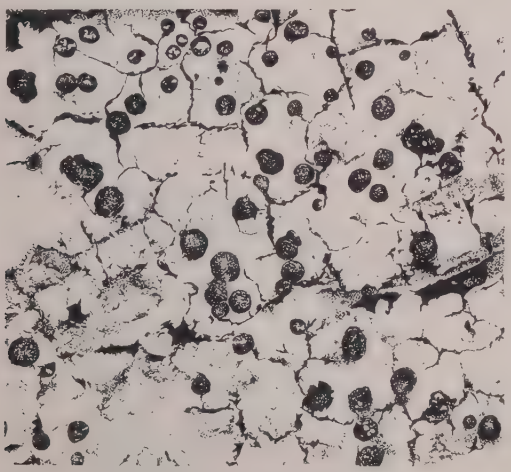


Fig. 20. *Bacidia spirospora* var. *patagonica* M. Lamb. Part of the type-specimen (× 4).

Thallus white or whitish, effuse, matt, very thin, not over 0.1 mm. in thickness, partly hypophloeodal, irregularly and grossly rimose from the cracking of the bark substratum, but really continuous, not areolate, smooth or indistinctly verruculose-rugulose, here and there with scanty, small, scattered soredial granules, but without distinct soralia. Faint traces of a blackish hypothallus visible here and there in the cracks. Thallus KHO– or indistinctly yellowish, $CaCl_2O_2$– , PD– . Medullary

hyphae 2–3 μ thick, I– , with walls of moderate thickness. Symbiotic algae protococcoid, pale green, globose, 3–7 μ diam., thin-walled, cohering in clumps. Apothecia numerous, scattered, sessile, moderately to well constricted at base, round, 0.6–1.0 mm. diam., at first plane and thinly marginate, then slightly convex and immarginate. Proper margin sometimes lighter (brownish), moderate, entire, matt or subnitid. Disc matt, naked, smooth or minutely scabrid.

Excipulum entire below apothecium, 50–70 μ thick, in lower part colorless and hyaline, at sides faintly yellowish (or sometimes dark reddish in uppermost part adjoining the hymenium), clear and translucent, composed of parallel, thick-walled, gelatinized-concrescent hyphae, the lumina either fistulose, about 1 μ wide, or oblong, up to 3 μ wide. Hypothecium of two distinct equal parts: (*a*) a lower, colorless, hyaline half and (*b*) an upper, sordid yellow-brownish, faintly pigmented half; both parts composed of fine, ± thin-walled hyphae 2–3 μ thick compactly intertexted in various directions, or almost pseudoparenchymatic. Total depth of hypothecium 135–170 μ. Occasionally parts of the upper hypothecium are stained dark reddish in irregular patches. Hymenium 75–100 μ high, densely dark aeruginose or aeruginose-blackish above, otherwise ± colorless and hyaline. Paraphyses discrete, about 1.5 μ thick, somewhat sinuose, at the tips clavate-capitate up to 5 μ and there aeruginose-pigmented and ± conglutinated. Asci 50–85 μ long, clavate, thickened at apices. Spores ± straight or usually sigmoid or spirally curved, anguilliform, usually tapered at one end, (8–) 12–15-septate, (47–) 60–68 × 3.5 μ, packed 6–8 in ascus, at first straight and parallel, finally distinctly though loosely spirally wound.

Found growing on the trunk of *Colletia* at the edge of the *Nothofagus* forest by Lago Cisnes near Lago Menéndez.

Type in Herb. Mus. Nat. Canada, Ottawa.

Stereocaulon (Enteropodium) **patagonicum** M. Lamb (n. sp.)

Pseudopodetia conferta, erecta, caespitosa, robusta, substrato arcte affixa, haud dorsiventralia, 2.5–7.0 cm. alta, 1–2 (–3) mm. crassa, modice et irregulariter ramosa, teretia, decorticata, glabra aut tomento mediocri laevi vestita; phyllocladia lateralia,

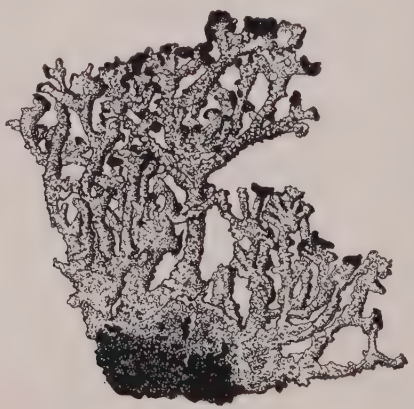


Fig. 21. *Stereocaulon patagonicum* M. Lamb. The type-specimen (× 1).

copiosa, albida aut glauco-cinerascentia, primum verrucosa, ad 0.3 (–0.5) mm. lata, dein (praesertim in partibus inferioribus) squamulosa et crenata, usque 0.8 mm. lata, saepe imbricata. Cephalodia lateralia, verrucoso-globosa, 0.5–1.5 mm. lata, phyllo-

cladiis concoloria aut parum obscuriora (violascenti-cinerea), algam Nostochineam continentia. Apothecia copiosa, terminalia, 1.0–3.0 (–3.5) mm. lata, obscure fusca aut fusconigricantia, e plano et tenuiter marginato mox convexo-immarginata, laevia, nuda. Stratum medullare apothecii (conus centralis) hyalinum, compactum, hyphis conglutinatis, saepe granulis opacis inspersum; hypothecium tenue, plus minusve sordide flavidulo-nubilatum vel fere hyalinum; hymenium 60–80 μ altum, purum, superne fuscescens. Sporae 8nae, cylindrico-fusiformes, rectae, 3 (–4)-septatae, longit. 30–44 μ, crassit. 3.0–3.5 μ. — Phyllocladia plerumque PD + rubescentia (planta acidum sticticum gerente). — Affinis *Stereocaulo tomentoso* Fr., sed erectius, robustius, minus aut haud tomentosum, et apotheciis magnis et terminalibus. Quod phyllocladia attinet, nexum quodammodo inter typos *St. tomentosi* et *St. paschali* var. *alpini* ostendit, nam haec in partibus inferioribus pseudopodetiorum plane ut in *St. tomentoso*, in partibus superioribus autem magis ea *St. paschali* var. *alpini* in memoriam revocantia. — Ad terram sabulosam in Argentina, Patagonia, Chubut, lacus Menéndez: M. Lamb, 1950, no. 5790 (typus speciei), et multis aliis locis in Patagonia argentinensi et chilensi.

Description of the type-specimen (*M. Lamb no. 5790*): Pseudopodetia crowded, stipate-caespitose, rooted firmly at the base into the earthy substratum, 2.5–4.5 cm. high, (0.8–) 1–2 mm. thick, slightly and irregularly branched, upright, rigid, not fragile, entirely decorticate, in places with a moderate smooth tomentum like that of *St. paschale*. Phyllocladia abundant and crowded in upper parts of pseudopodetia, often more abundant on one side, in lower parts often more scattered and showing the pseudopodetial surface in between; upper ones of the typical *alpinum*-type (at first simply verrucose, up to 0.2 mm. diam., then becoming lobate at the edges and convex-subsquamuliform, up to 0.3 or 0.5 mm. diam.), lower ones more divided, digitate-crenate or digitate-squamulose, rather similar to those of *St. tomentosum*. Cephalodia common, lateral on pseudopodetia, among the phyllocladia, forming globose-verrucose or verruculose masses 0.5–1.5 mm. diam., constricted at base, light-colored ($\pm$ concolorous with the phyllocladia or slightly darker, purplish-cinerascent), often with minute darker spots on the surface; containing *Stigonema*. Phyllocladia KHO + yellow, PD + (slowly) sulphur-yellow deepening to orange-red. Apothecia abundant, terminal on ends of pseudopodetia, 2–4 mm. diam., dark brown or brown-blackish, at first plane with distinct, raised, concolorous proper margin, then soon slightly to strongly convex, with the margin excluded. Disc smooth, matt, not pruinose.

Excipulum poorly developed, almost obsolete, of radiating structure, colorless and $\pm$ hyaline, in places covered by a thin layer of pseudopodetial cortical tissue. Central cone cleft and ruptured, colorless, hyaline, compact, without inclusions, of gelatinized structure, appearing to be made up of leptodermatic hyphae about 3 μ thick loosely interwoven and embedded in transparent mucilage. Hypothecium 60–80 μ deep, not sharply differentiated from the central cone, slightly yellowish-gray-cloudy in section, not pigmented. Hymenium 60–70 μ high, brown above. Spores 3-septate, cylindrical-fusiform, straight, 35–48 $\times$ 3 μ.

Belongs to sect. *Eustereocaulon*, and is most closely related to *St. tomentosum* Fr., from which it differs in the robust, erect habitus and large terminal apothecia. The lower phyllocladia are unmistakably like those of *St. tomentosum*, but the upper ones are more convex-verrucose, like those of *St. paschale* var. *alpinum* (Laur.) Mudd. It was recognized as a distinct species from material seen in various herbaria, and this impression was confirmed by subsequent study of the populations in their natural habitat. Specimens have been seen to date from about 26 different localities in Argentine and Chilean Patagonia (Río Negro, Neuquén, Chubut, Santa Cruz, Chiloé, Aysén and Magallanes), and it would appear to be common between latitudes 40° and 55° S. It was recorded from the National Park of Nahuel Huapí in Río Negro by Räsänen in *An. Soc. Cient. Argent.*, Vol. CXXVIII, 136: 1939, under the erroneous identification of "*Stereocaulon myriocarpoides* Nyl." (specimen seen in Herb. Räsänen).

The type population especially studied in Chubut, W. end of Lago Menéndez, was on the sandy gravelly shore of the lake behind the beach, near the edge of the *Nothofagus* forest, where it occurred intermixed with a sward of *Stereocaulon paschale*.

Among the latter it grew in sporadic isolated tufts, which were very distinct by their larger stature and abundant apothecia. The pseudopodetia are always firmly rooted into the earthy substratum or onto small stones.

Type in Herb. Mus. Nat. Canada, Ottawa; isotype in Farlow Herb.

F. subirregulare M. Lamb (n. f.)

Caespites deplanatos, compactos et crustosos formans, phyllocladiis valde congestis, verrucosis aut crenato-squamulosis. Pseudopodetia demum elongata, irregularia, parcius phyllocladiis tecta, partim denudata; apothecia terminalia, mox corymbose divisa. — Ad rupes et inter lapides in cacumine montis Rigi prope lacum Frias, altit. circ. 1750 m.: M. Lamb, 1950, nos. 5788, 5789 (typus).

Fig. 22. *Stereocaulon patagonicum* f. *subirregulare* M. Lamb. The type-specimen (× 1).

Description of the type-specimen (*M. Lamb no. 5789*): Forming compact, flattened-pulvinate tufts, firmly attached to the rock or in clefts between stones, cinerascent whitish, with the phyllocladia very crowded and forming a crust. Tufts widely attached on underside, ± dorsiventral; phyllocladia mostly verrucose, about 0.25 mm. diam., in places larger, up to 0.8 (–1.0) mm. diam. and flattened-crenate, like those of *St. paschale* var. *alpinum* (Laur.) Mudd; pseudopodetia finally irregularly elongated, 3.0–4.5 cm. long, partly denudated, partly covered with scattered or aggregated phyllocladia. Apothecia terminal on the pseudopodetia, 1–2 mm. diam., convex and immarginate from the first, soon dividing to form heads of numerous small secondary discs on corymbose stalks. Cephalodia fairly numerous on upper side of tufts among the phyllocladia, pulvinate, up to 3 mm. diam., dark cinereous, verruculose-tuberculate or ± botryose, containing *Stigonema*. Phyllocladia PD + (slowly) orange-red.

Central cone ruptured, compact, gelatinized, clear and hyaline but with some scattered inclusions of sordid yellowish depsidone-substance. Hypothecium 100–120 μ deep, isabelline-cloudy in upper half. Hymenium 65–78 μ high. Spores straight, 3–5-septate (the septa often indistinct), 34–50 × 3.5 μ.

Differing from the typical species in the more compacted and irregular habitus, which resembles that of *St. botryosum* f. *irregulare* H. Magn. From the latter it can be distinguished by the larger, ashy-whitish, finally crenate-squamulose phyllocladia.

The two specimens were found at the summit of the Cerro Rigi, above the tree limit,

in a very exposed and windswept position probably with little or no protecting snow cover in winter.

Type in Herb. Mus. Nat. Canada, Ottawa; isotype in Farlow Herb.

Stereocaulon paschale (L.) Hoffm., var. **alpinum** (Laur.) Mudd, f. **flabellans** M. Lamb (n. f.)

Pseudopodetia valde dorsiventralia, substrato arcte applanata, insigniter flabellatim expansa, phyllocladiis majusculis, deplanato-squamulosis, crenatis, congestis obtecta. — Terricola inter rupes et lapides in Argentina, Patagonia, Río Negro, in cacumine montis Rigi prope lacum Frias: M. Lamb, 1950, nos. 5786, 5787 (typus).

Fig. 23. *Stereocaulon paschale* var. *alpinum* f. *flabellans* M. Lamb. Part of the type-specimen (× 3).

Description of the type-specimen (*M. Lamb no. 5787*): forming small spreading tufts flattened and appressed to the ground, 2.5–4.0 cm. across, becoming ± confluent to cover large areas of ground; pseudopodetia copiously branched in a spreading fan-like fashion, the upper side entirely concealed by the phyllocladia; seen from the under side they are ± terete, 0.4–1.0 mm. thick, roseate-whitish to pallid ochraceous, glabrous or with a thin, subtle, concolorous tomentum. Phyllocladia very numerous on upper side, crowded, flattened-squamulose, 0.7–1.0 mm. diam., incised-crenate at the edges, white or whitish, often tending to fuse together. Cephalodia not abundant, on the under side, smooth, ± globose, sometimes aggregate-verrucose, 0.3–0.7 (–0.9) mm. diam., light-colored (whitish or faintly dull roseate), containing *Nostoc*. Phyllocladia KHO + yellow, PD + (slowly) orange-red. (Sterile.)

On the summit plateau of the Cerro Rigi, at an altitude of about 1750 m., this form presented a very striking appearance on account of its decumbent, closely adpressed, flabellate-radiating habitus. The fan-like groups of pseudopodetia were congregated over fairly wide areas of ground, and were only loosely attached to the substratum. The patches were on open flat ground, in a position where probably considerable flooding of the ground takes place by snowmelt water in spring. Both collections gave the same orange-red reaction of the phyllocladia with Paraphenylenediamine, and are hence referable to the Stictic acid strain of the species.

Type in Herb. Mus. Nat. Canada, Ottawa; isotype in Farlow Herb.

Stereocaulon (Enteropodium) **speciosum** M. Lamb (n. sp.)

Pseudopodetia caespites usque 30 cm. latos formantia, erecta vel varie intricata, maxima, robusta, (5–) 8–10 (–13) cm. longa, 2.5–5.0 mm. crassa, simplicia vel parum ramosa, cylindrica, apicibus cornuto-acuminata; decorticata, superficie inter phyllocladia laevi aut nonnihil spongioso-fibrosa, phyllocladiis albidis circumcirca dense obtecta, partibus infimis emorientibus et fuscis, illic phyllocladiis destituta. Phyllocladia conferta, verrucosa, 0.2–0.5 (–0.8) mm. lata, vulgo stipitata, saepius centro obscurius (olivacee- aut fusco-ochracee-) maculata. Cephalodia inter phyllocladia sessilia, irregulariter pulvinata, rufofusca aut fusconigricantia, 0.6–1.0 mm. lata, minute verruculosa, *Stigonemam* continentia. (Apothecia ignota.) — Phyllocladia (saltem apices pseudopodetiorum versus) PD + rubescens (planta acidum sticticum gerente). — Ad stirpem *Stereocauli vesuviani* pertinet, *St. cornuto* Müll. Arg. habitu cornuto-acuminato haud dissimile, sed multoties robustius, cephalodiis aliis, apotheciis destitutum

Fig. 24. *Stereocaulon speciosum* M. Lamb. Part of the type-specimen (× 1).

(haec in *St. cornuto* vulgatissima). Aspectu portentoso, inter species spectabilissimas generis adnumerandum. — Ad terram sabulosam in Argentina, Patagonia, Chubut, lacus Menéndez: M. Lamb, 1950, nos. 6069 (typus speciei), 6071, et ibidem jam anno 1940 a cel. O. Kühnemann lectum; quoque in aliis locis Patagoniae argentinensis et chilensis obvium.

Description of the type-specimen (*M. Lamb no. 6069*): Forming caespitose clumps up to 30 cm. across of variously intricated or upright pseudopodetia which are gradually brown and emorient in lower parts: the living parts with a cover of whitish phyllocladia are 3–7 (–9) cm. long, 2.5–5.0 mm. thick, simple or only sparingly branched, branching off from a common stem in the lower part, terete, cylindrical, cornute-acuminate towards the tips, ± thickly covered on all sides with crowded phyllocladia. Surface of pseudopodetia between phyllocladia decorticate, terete, pale ochraceous, with ± smooth to slightly spongy-fibrose surface, in places almost felted-tomentose. Phyllocladia crowded and contiguous, ± concealing the podetia, mostly distinctly stalked and usually in groups of 3–10 or more on simple or branched pedicels 0.5–2.0 mm. long; small, 0.2–0.3 (exceptionally up to 0.8) mm. diam., predominantly verrucose, always with distinct, olivaceous- or ochraceous-brown centers, which are minute and spot-like in the smaller phyllocladia, ± expanded in the few larger, ± flattened phyllocladia. Phyllocladia white to cream-colored, without any violascent tinge, smoothly corticate, matt or subnitid. Cephalodia common, ± conspicuous, sessile among the phyllocladia, dark red-brown to brown-blackish, matt or ± pellucid, verruculose or botryose, irregularly pulvinate, 0.6–1.0 mm. diam., containing *Stigonema*. Phyllocladia KHO + yellow, PD + (slowly) orange to orange-red. (Sterile).

In its habitus the new species, which belongs to sect. *Leucocheilon*, subsect. *Peltophyllum* M. Lamb (in *Canad. Journ. Bot.*, Vol. XXIX, 566–7: 1951), somewhat closely resembles the Jamaican *St. cornutum* Müll. Arg., having the same type of very tall pseudopodetia of markedly cornute growth. It differs from that species, however, in its much more robust and thick pseudopodetia, 2.5–5.0 mm. thick including the phyllocladial covering; in *St. cornutum* the thickness rarely exceeds 2 mm. The dark, verruculose-botryose cephalodia are also different from those of *St. cornutum*, in which they are aeruginose-cinereous and never distinctly botryose.

Field observation showed that this handsome species grows optimally on mossy gravelly soil in the open scrub formations on morainic hills, in Chubut at about 650 m. above sea level. In spite of careful search, no fruiting specimens could be found; this affords another contrast against *St. cornutum*, which is nearly always abundantly fertile. Other specimens seen were from Río Negro in Argentina and Aysén and Llanquihue in Chile.

Type in Herb. Mus. Nat. Canada, Ottawa; isotype in Farlow Herb.

Var. **surreptans** M. Lamb (n. var.)

Pseudopodetia prostrata, substrato adpressa, haud vel vix affixa, laxe reptantia et intricata, subradiatim vel flabellatim ramosa, crassissima (3–7, rarius ad 10 mm. crassa). — Terricola in Argentina, Patagonia, Río Negro, in cacumine montis Rigi prope lacum Frias: M. Lamb, 1950, no. 6098; etiam e Valdivia et Ecuador visum.

Exsicc.: Lich. Austroamer. ex Herb. Regnell. no. 391 ("*Stereocaulon obesum* Th. Fr."), from Ecuador, Prov. León, Cotopaxi, coll. E. Asplund, 1939.

Description of the type-specimen (*M. Lamb no. 6098*): Pseudopodetia not or hardly attached to the substratum, lying prostrate, flattened to the ground, loosely spreading or entangled, copiously branched in an irregularly radiating or ± flabellate fashion. Pseudopodetia 3–7 (–10) mm. thick (including the phyllocladial covering), the upper side closely covered with crowded phyllocladia, towards center of underside without phyllocladia and covered with adherent earth. Tips of pseudopodetia cornute-attenuated. Phyllocladia crowded, covering and concealing the pseudopodetia, verrucose, 0.4–0.9 mm. diam., often ± confluent; whitish or cinereous, matt, often without distinct darker centers; the latter, when present, minute, spot-like, olivaceous-glaucescent. Cephalodia numerous, present chiefly on upper side among the phyllocladia, forming irregular, pulvinate-confluent, brown-blackish masses with obsoletely verruculose surface; containing *Stigonema*. Phyllocladia PD + (slowly) orange to orange-red. (Sterile.)

Found on flat soil beds in slight hollows between rocks and stones in exposed positions on the summit plateau of the Cerro Rigi, apparently sites which are long covered by snow in winter and undoubtedly strongly inundated by snowmelt water in springtime. The scattered or confluent, loosely spreading pseudopodetial mats cover areas up to 2 square meters in extent, and lie prostrate and almost unattached. The

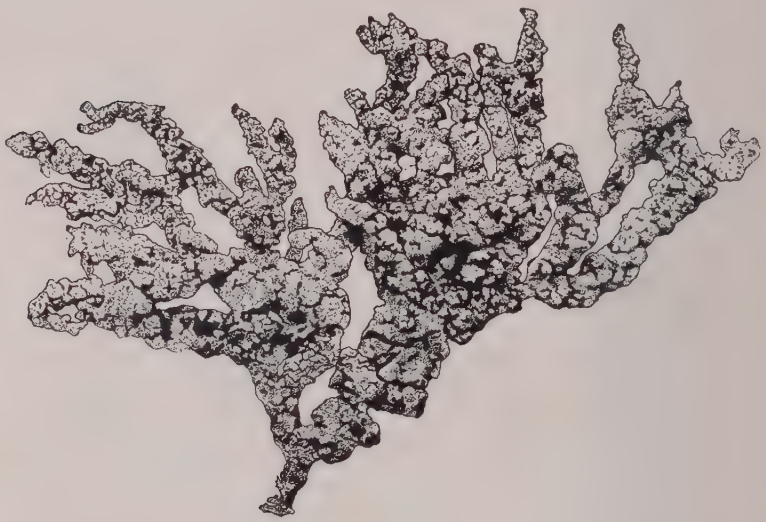


Fig. 25. *Stereocaulon speciosum* var. *surreptans* M. Lamb. Part of the type-specimen (× 1).

specimen from Ecuador distributed in Lich. Austroamer. ex Herb. Regnell. no. 391 is composed of much smaller tufts, but the habitus is the same and the pseudopodetia are quite as thick as in the type material. The Chilean specimens seen (also sterile) are from the Volcán Villarica, coll. Claude Joseph, 1931, and A. Pfister, 1935.

Type in Herb. Mus. Nat. Canada, Ottawa; isotype in Farlow Herb.

Stereocaulon argus Hook. f. & Tayl. emend Th. Fr., var. **stenospermum** M. Lamb (n. var.)

Sicut species typica, at hypothecio sat hyalino et fere pellucido (ut in *St. implexo*), nec nubilato, et sporis angustioribus, longit. 37–60 μ, crassit. (3.5–) 4–5 μ (in specie typica sunt crassiores, 5–7 μ). — Saxicola in Argentina, Patagonia, Río Negro, prope amnem glacialem Frias: M. Lamb, 1950, nos. 6088 (typus), 6092, et in Chubut, lacus Menéndez: M. Lamb, 1950, no. 6077.

Description of the type-specimen (*M. Lamb no. 6088*): Pseudopodetia forming caespitose tufts, upright, firmly attached to the substratum, moderately branched from near the base and upwards, rigid, the basal portions somewhat woody; 5.0–7.5 cm. high, 1.5–2.5 (–3.0) mm. thick, thinner at the base, which is decorticate; other parts corticate with a continuous or fissured, smooth to wrinkled-scrobiculate cortex, cinereous-whitish or cinereous-glaucescent, glabrous. Phyllocladial branchlets not abundant, mostly developed towards the base, scanty or absent in upper parts of pseudopodetia, coralloid, cylindrical, 0.25–0.40 (–0.50) mm. thick, the lower

ones irregularly branched, up to 8 mm. long, the upper ones becoming shorter and simple and finally passing into papillate excrescences of the cortex; concolorous with the pseudopodetia, not lighter at tips, their cortex smooth or transversely cracked. The lower phyllocladial branchlets are harmonic, not distinguishable from fine pseudopodetial side-branches. Cephalodia moderately numerous, lateral on pseudopodetia,

Fig. 26. *Stereocaulon argus* var. *stenospermum* M. Lamb. The type-specimen (× 1).

usually slightly stalked, sacculate, moderately to strongly scrobiculate-indented or cerebriform, irregular in shape, 1.5–2.0 (–3.5) mm. diam., gray to glaucous-cinereous or brownish-gray, internally loose and arachnoid, bounded by a palisade-cortex 28–35 μ thick, containing *Stigonema*-filaments. Apothecia terminal, abundant, 1.5–3.0 (–4.0) mm. diam., soon convex, at first with a ± reflexed, paler (pale brownish) proper margin which is foveolate-scrobiculate on the underside, finally ± excluded. Larger apothecia becoming furrowed and finally separating into several imperfectly divided pulvinate portions. Disc dark brown or brown-blackish, ± matt, naked, smooth. Phyllocladial branchlets KHO + yellow, PD + (slowly) sulphur-yellow (not turning red).

Excipulum reflexed and corrugated, continuous to the pseudopodetium below, 65–100 μ thick, colorless and hyaline in outer part, brownish-gray-nubilated and opaque within; composed of parallel, conglutinated, thick-walled hyphae. Central cone up to 340 μ deep, lax in texture, heavily inspersed with sordid brownish-gray granules and ± opaque in section. Hypothecium 100–135 μ deep, ± sharply limited from central cone, faintly sordid yellowish or ± colorless in section, ± clear and transparent, without granules or inclusions, compact. Hymenium 100–120 μ high, brown in upper 10–13 μ, otherwise ± colorless and hyaline. Paraphyses discrete, 1.5–2.0 μ thick, capitate to 5 μ at the brown tips. Spores seen 4–6 in ascus, not spirally wound; straight or slightly bent, cylindric-fusiform, 3–7 (–8)-septate, 37–60 × (3.5–) 4–5 μ, sometimes breaking up into 1–2-septate pieces with rounded ends.

Pycnidia numerous at ends of some of the pseudopodetia, forming botryose clusters of gray or pale brownish verruculae 0.15–0.30 mm. diam. Conidia filiform, arcuate or rarely almost straight, 10–14 μ long, about 0.5 μ thick.

In the type material of *St. argus* from Campbell Island the hypothecium is nubilated and opaque right up to the base of the hymenium, and the spores are (4–) 5–6 (–7) μ broad. In other respects the Patagonian variety shows close agreement with it.

The variety has been seen in three localities in Argentine Patagonia, two in Río Negro and one in Chubut, and had also been previously collected from two localities in Río Negro by V. Kull in 1938, as an admixture with other species. It grows firmly attached to rocks in open positions, usually associated with *St. implexum* Th. Fr., but scarce, never forming widespread associations like the latter.

Type in Herb. Mus. Nat. Canada, Ottawa; isotype in Farlow Herb.

Stereocaulon corticatulum Nyl., var. **procerum** M. Lamb (n. var.)

Pseudopodetia altiora quam in specie typica, usque 4 (–5) cm., laxe caespitosa, apicibus et hinc inde lateribus semper effuse sorediata, pro maxima parte decorticata (cortice tantum passim squamulose evoluto, praesertim in ramulis tenuioribus). — Saxicola in Argentina, Patagonia, Río Negro, prope lacum Frias: M. Lamb, 1950, no. 6086.

Fig. 27. *Stereocaulon corticatulum* var. *procerum* M. Lamb. The type-specimen (× 3).

Pseudopodetia loosely caespitose, upright, firmly attached to the rock, (1.5–) 2–4 (–5) cm. high, 0.7–1.0 (–1.3) mm. thick, irregularly branched from near the base and upwards, almost entirely decorticate, the cortex persisting only in a few places as isolated patches or squamules, chiefly on the finer branches; smooth, ± rigid, subochraceous-whitish or whitish with a faint roseate tinge, glabrous. Soredia effuse, not capitate, mostly terminal on the pseudopodetia and branches, a few also scattered lower down on the sides; minutely granulose, white or glaucous-whitish. The phylloclad-ial branchlets are indistinct as such, being irregular and harmonic. Cephalodia fairly numerous, laterally sessile on pseudopodetia or terminal on short side-branchlets, whitish to glaucescent, in young stages subglobose with smooth, unicolorous or slightly variegated surface, then becoming larger, up to 1.5 (–2.0) mm. diam., and distinctly foveolate-indented, almost as in *St. ramulosum* (Sw.) Räusch., occasionally perforated or cracked to reveal the dark reddish algae (apparently *Gloeocapsa*) in the interior. Internal hyphal tissue loose and arachnoid; outer cortex either pseudo-parenchymatic and ± nubilated, partly clear and composed of gelatinized, parallel palisade-hyphae. Soredia and corticate parts KHO + yellow, PD + (slowly) sulphur-yellow (not turning red). Apothecia rare, terminal, 0.8–2.0 (–2.3) mm. diam., pulvinate-convex and immarginate at maturity, brown-blackish, matt, not pruinose.

Excipulum well developed at sides and below, 50–90 μ thick, colorless or faintly sordid yellowish, clear, composed of parallel, conglutinated, thick-walled hyphae. Central cone up to 400 μ deep in center, mostly loose in texture and clear to slightly inspersed, in upper 50–70 μ more compact and more densely sordid yellowish-gray-inspersed. Hypothecium sharply limited from upper central cone, 35–47 μ deep, colorless and hyaline. Hymenium 65–75 μ high, brown in upper 9–14 μ, otherwise colorless and hyaline. Paraphyses discrete, 1.0–1.5 μ thick, capitate to 3.0–3.5 μ at the brown tips. Spores few in ascus, about 4, straight, cylindric-fusiform, 3-septate, 40–60 × 3.0–3.5 μ.

Stereocaulon corticatulum was originally described from New Zealand, and has not been recorded in the literature from outside that country. It is, however, apparently not uncommon also in the southern parts of South America, and was found by the present writer in a number of localities along the shores of the lakes of Río Negro and Chubut. *Stereocaulon subcorticatum* Räs. in *Ann. Bot. Vanamo*, Vol. II, no. 1, 24: 1932, from western Fuegia, is conspecific with *St. corticatulum*, and should be called *St. corticatulum* var. *subcorticatum* (Räs.) M. Lamb (in *Canad. Journ. Bot.*, Vol. XXIX, 581: 1951). Other synonyms for the typical species are *Stereocaulon leptaleum* Nyl., *St. corticatulum* subsp. *detergens* Nyl., and *Stereocaulon humile* Müll. Arg., the latter perhaps to be segregated as a distinct variety, but requiring further study. *St. corticatulum* is one of the more primitive members of the subgenus *Holostelidium* (sect. *Sacculata*, subsect. *Aciculisporae*, cfr. M. Lamb, *op. cit.*, p. 565). The var. *procerum* here described is distinguished by its taller pseudopodetia which are loosely caespitose and constantly effusely sorediate at the apices and on the sides.

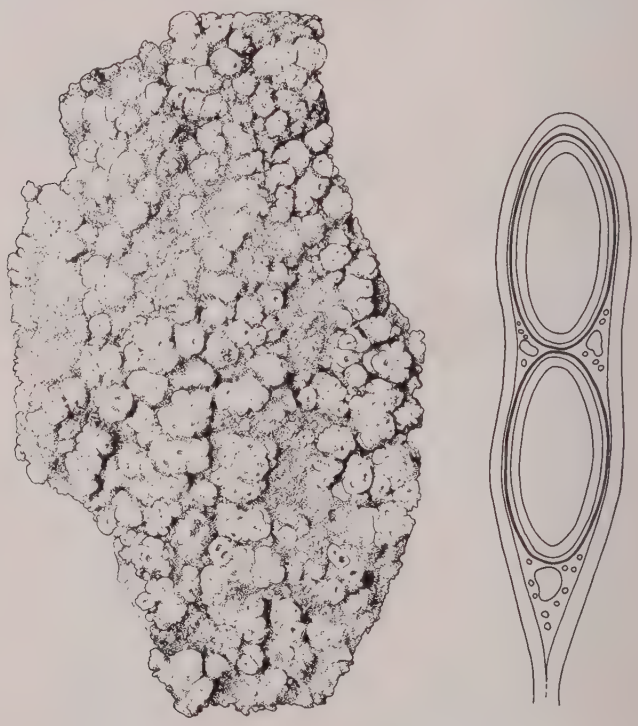
The type material was found growing on rock faces beside a stream in open *Nothofagus* forest, associated with *St. implexum* Th. Fr., along the trail between Lago Frias and the Frias Glacier in Río Negro.

Type in Herb. Mus. Nat. Canada, Ottawa; isotype in Farlow Herb.

Pertusaria (Eupertusaria) **victoriana** M. Lamb (n. sp.)

Thallus effusus, linea nigricante nulla ut videtur limitatus, fere omnino e verrucis fertilibus constans, albidocinereus (apicibus verrucarum interdum pauxillisper ochraceo-tinctis), opacus; isidia et soredia desunt. Verrucae fertiles confertae, subglobosae, 0.8–1.3 mm. latae, passim 2–3 confluentes et dein 1.5–2.0 mm. latae; 1–2-carpicae, basi modice aut bene constrictae, haud pulverulentae; disculis sat profunde impressis, haud annulatis, nigrescentibus, nudatis aut interdum pruina alba superfusis, rotundatis, primo punctiformibus, dein leviter apertis et 0.2–0.3 mm. latis. Epithecium sordide inspersum, hymenium circ. 450 μ altum, paraphyses tenues, fili-

formes, ramoso-connexae et intricatae. Sporae binae, incolores, ellipsoideae aut ellipsoideo-oblongae, 90–140 × 56–70 (–75) μ, pariete duplici praeditae, membrana externa amorpha aut subtiliter granuloso-porosa, interna hyalina, laevigata, haud striolata nec costulata. — Thallus extus KHO – aut maculatim rubescens, PD + leviter lutescens, intus KHO + lutescens deinque mox sanguineo-rubescens (crystallis acicularibus praecipitatis), PD + bene et persistenter flavescens; $CaCl_2O_2$ et Iodo haud reagens. Epithecium KHO + subviolascens. — *P. albidopallenti* Nyl., e Fuegia descriptae, forsan maxime affinis. — Saxicola prope lacus litora in Argentina, Patagonia, Río Negro, insula Victoria in lacu Nahuel Huapí: M. Lamb, 1950, no. 5817.



Figs. 28 & 29. *Pertusaria victoriana* M. Lamb. The type-specimen (× 3). An ascus with spores (× 230).

Thallus effuse (no peripheral dark line seen), consisting almost entirely of crowded fertile verrucae; the few sterile areolae present between the fertile verrucae tumid and convex, about 0.4 mm. diam. No distinct hypothallus developed. Color whitish-gray, without any yellowish tinge, but the tops of the fertile verrucae sometimes with a faint ochraceous tinge; not shining. No isidia or soredia. Fertile verrucae crowded and often several confluent, irregularly subglobose, 0.8–1.3 mm. diam. (confluent groups of 2–3 are 1.5–2.0 mm. diam.), moderately to well constricted at base, not pulverulent, 1–2-carpic. Discs ± impressed, blackish, naked or occasionally whitish-pruinose, round, at first punctiform, then widening to 0.2–0.3 mm., not surrounded by any annulus. Thallus and verrucae externally KHO– or red in spots, PD + faint

yellow; internally KHO + yellow then blood-red (with formation of acicular crystals under the microscope), PD + persistent yellow. $CaCl_2O_2$– , I– , both externally and internally. Symbiotic algae protococcoid, bright or yellowish green, globose, separate, thin-walled, 10–20 μ diam.

Margin of fertile verrucae with abundant algae. Excipular tissue around apothecia 15–60 μ thick at sides, up to 75 μ thick at apex, not pigmented, but ± grayish-nubilated, especially around the ostiole. Hypothecium blackish in section from included air (like the whole of the rest of the thallus). Hymenium subglobose or ± flat and dilated, about 450 μ high, in uppermost 30–50 μ with an irregular, dark gray-nubilated but not or hardly pigmented epithecium (KHO + sordid violet). Paraphyses 1.0–1.5 μ thick, entangled, copiously branched and often anastomosing. Asci clavate, 320–390 × 65–78 μ, with colorless, non-striated wall 5–6 μ thick at sides and up to 10 μ thick in lower part. Spores 2 per ascus, placed end to end, colorless, ellipsoid or oblong-ellipsoid, 90–140 × 56–70 (–75) μ; wall distinctly double; outer wall 3–5 μ thick, of the same thickness all round, sometimes smooth and structureless, more often minutely granulose-porose (this more distinct in KHO), occasionally indistinctly longitudinally striated; inner wall 3–8 μ thick, sometimes thicker at ends, hyaline, not striated or costulate, smooth on inner side. The boundary between inner and outer walls appears as a highly refractive line. Spore-contents sometimes faintly longitudinally striated. Asci persistently dark blue with Iodine.

From the literature, this species seemed to be closely related to *P. albidopallens* Nyl. (from Fuegia), *P. alterimosa* Darb. (from the Falkland Islands), and *P. subverrucosa* Nyl. (from New Zealand). The type material of these species was therefore obtained and examined. *P. alterimosa* (see revision below), although resembling our species in many respects, is a *Lecanorastrum*, with more irregular, finally lecanorine fertile verrucae and brownish discs up to 0.8 mm. in diameter. Its spores also differ in having a single wall only. *P. albidopallens* (see revision below) has a thinner, verrucose-areolate or rugose-areolate thallus with a distinct pale reddish tinge, less crowded, more flattened, ± lecanorine fertile verrucae with larger, white-farinose discs, and its spores (according to another authentic specimen in Herb. Nylander) have a simple wall. *P. subverrucosa,* as far as can be seen from the minute type fragment in Herb. Nylander (no. 22954), coll. Colenso, no. 4694, stuck down so that the substratum cannot be seen, differs from *P. victoriana* in the thick, smooth, ± continuous or slightly rimose thallus and the absence of distinctly delimited fertile verrucae; the black, naked, impressed-punctiform discs (up to 0.5 mm. diam., including the blackened margin) are immersed in the thallus, not forming distinct separate fertile verrucae. According to Nylander, the specimen probably grew on rock; Zahlbruckner in *Cat. Lich. Univ.* gives it as a corticolous species. Nylander described the thallus as nodulose-crenate at the periphery, but this is not distinctly seen in the type fragment. No microscopic examination was made on account of the scantiness of the material. Of other species known to the writer only from the literature, *P. knightiana* Müll. Arg. (from New Zealand) differs in the ± smooth and rimose thallus and the larger spores with thicker, reticulate-costate wall, and *P. zahlbruckneri* H. Magn. (from Hawaii) is distinguished by the annulate margin of the apothecial discs and the longer spores with transversely rugulose inner wall. *P. victoriana* belongs to subgen. *Eupertusaria*, sect. *Rubescentes* Erichs. (in *Rabh. Krypt.-Fl.*, Vol. IX, Abt. 5, Teil 1, 341: 1935).

Type in Herb. Mus. Nat. Canada, Ottawa; isotypes in Farlow Herb. and Herb. Inst. Bot. Darwinion, San Isidro, Buenos Aires.

Pertusaria albidopallens Nyl.

Lich. Fueg. et Patagon., 22: 1888.

The following is an external description of the type-specimen of *P. albidopallens* Nyl. from Cape Horn, coll. Hariot, 1885 (no. 23817 in Herb. Nyl.): small fragment, about 9 × 6 mm., on chips of rock. Periphery of thallus not present. Thallus of

moderate thickness (0.2–0.5 mm.), verrucose-areolate or rugose-areolate, the areolae ± distinct, tumid and convex, of irregular shape, 0.3–0.6 mm. diam., more or less completely separated by narrow or partly closed-up cracks. No dark hypothallus developed. Thallus cream-colored or isabelline with a distinct pale reddish tinge, matt, the surface of the areolae smooth. No isidia or soredia. Medulla macroscopically white, dense. Thallus-fragments crushed out under microscope KHO + yellow mist then forming abundant red spicular crystals. Fertile verrucae numerous, scattered or sometimes 2–3 contiguous, ± lecanoroid, sessile on the thallus and usually distinctly constricted at the base, round or slightly irregular in outline, 0.8–1.2 mm. diam., flattened-subglobose or convex-discoid, flattened at the apex and there ± widely white-farinose with expanded flat disc up to 0.6 mm. diam., which is either entirely white-farinose or sometimes with the blackish epithecium ± visible beneath the pruina. Thalline margin thickish, non-prominent, ± entire, concolorous with the rest of the thallus. The specimen was too scanty to permit any apothecia to be taken for sectioning. Another specimen in Herb. Nylander referred, obviously correctly, to *P. albidopallens* (no. 23818), from Cape Horn, "ex hb. Hook. (nomine 'globulifera')," is somewhat larger and better developed. In habitus it is quite similar to the Hariot type-fragment; the fertile verrucae up to 1.7 mm. diam. Thallus under microscope KHO + yellow mist then red crystals. Spores seen in crushed preparation only outside ascus, colorless, about 165 × 72 μ, with colorless, single, smooth, not striate or costate wall 4–7 μ thick.

The species should perhaps be referred to the subgen. *Lecanorastrum*.

Pertusaria alterimosa Darb.

in *Wiss. Ergebn. Schwed. Südpolar-Exped. 1901–1903*, Vol. IV, Lief. 11, 7, Pl. 1, fig. 11: 1912.

The following is a revision of the type-specimen from the Falkland Islands, Port Louis, coll. C. Skottsberg, 1902 (no. 25) in Herb. Naturhist. Riksmus. Stockholm:

On metamorphic rock, associated with a *Lecidea*-sp. Thallus effuse, indeterminate or bounded by other crustaceous lichens, forming a patch 4 cm. across; cream-colored with a slightly ochraceous tinge, matt, uneven, of very variable thickness (0.3–1.5 mm.), the thinner parts reticulate-rimose or rimose-areolate with plane or slightly tumid, irregular, indistinctly delimited areolae 0.3–0.5 mm. diam.; the thicker parts coarsely rimose-areolate or glebose with irregularly rounded or angulose, almost columnar areolae 1–2 mm. diam. separated by deep and wide cracks, ± flat or verrucose-rugose on their upper surface, with vertical sides (not constricted at base), most of them fertile with 1 or 2 apothecia. No isidia or soredia. Medulla white and dense macroscopically; no trace of any basal dark hypothallus. A black line is developed at the junction with the neighboring lichen (a *Lecidea*), but appears to be produced by the latter. Thallus externally and internally KHO + yellow then soon blood-red, with red spicular crystals under the microscope, PD + persistent intense yellow, $CaCl_2O_2$– , I– . Apothecia ± lecanorine, the disc at first deeply sunken and of ± thelotremoid appearance, then soon expanding and from sunken becoming finally level with the surface of the verruca; at maturity 0.3–0.8 mm. diam., sordid brownish, matt, naked or with a sparse white granulate pruina (possibly mould!), concave to plane, sometimes 2 confluent; the thalline margin surrounding them irregular, finally becoming thin and often ± lacerated, not distinctly crenulate.

Apothecia bounded at the sides by a thin but ± distinct proper margin 20–30 μ thick consisting of tangential, parallel, conglutinated hyphae 1.0–1.5 μ thick; ± sordid yellowish-cloudy in section. On the outside of the proper margin is a thickish or thin thalline margin consisting of heavily sordid yellowish-nubilated tissue of indistinct structure, containing abundant to scanty, pale green protococcoid algae 6–9 μ diam. Hypothecium bowl-shaped or lentiform, thinning out at the sides, 150–170 μ deep in center, heavily yellowish-gray-nubilated and opaque in section. Hymenium 350–375 μ high, clear and colorless or isabelline-cloudy, with an irregular,

sordid-yellowish, granulose epithecium in its uppermost 20–35 p. Paraphyses distinct, 1.0–1.3 μ thick, branched and anastomosing. Asci clavate, 350–375 μ long, about 75 μ broad, with hyaline, non-stratified wall 8–15 μ thick, mostly 2-spored, a few 1-spored. Spores lying one above the other, ellipsoid or oblong-ellipsoid, colorless, 100–130 $\times$ 55–60 μ (or up to 180 $\times$ 85 μ when single in ascus), with grumose-guttulate protoplasm and hyaline, non-striated wall 3–5 μ thick smooth on both inner and outer sides. Asci blue then dark aeruginose with Iodine.

The specimen is not in very good condition; some of the fertile verrucae are hollow, having lost their hymenia. It is distinctly a *Lecanorastrum*. The younger fertile verrucae with deeply sunk hymenium call to mind the appearance of *Thelotrema* or *Lecidea* (*Biatora*) *coarctata*, although no distinctly separate proper margin is visible. Darbishire's photograph of the specimen is very good, but his description is misleading in several respects. "Thallus ad 2 mm latus" must refer to the diameter of the fertile areolae; the whole thallus is 4 cm. across. There is no yellowish tinge in its color. The fertile verrucae hardly exceed 2 mm. in diameter, and the discs now present are not over 0.8 mm. in diameter; they are sordid brownish, not at all concolorous with the thallus. No 3-spored asci were seen by the present author.

Usnea (Euusnea) **kuehnemannii** J. Mot. (n. sp.)

Thallus 11–20 cm. longus, pendulus, tenuis, modice ramosus, sat elasticus, obscure stramineus aut fusco-flavescens, opacus vel parum nitidus; rami primarii 0.5–0.8 mm. crassi, partim laeviuscule teretes, partim foveolato-scrobiculati et rugis angulosis ornati; rami terminales laeves, teretes, tenuiter capillacei. Soredia in ramis tenuioribus haud rara, minuta, farinosa, sparsa aut passim confluentia, haud prominula, flavido-albicantia. Medulla sat crebra, alba; axis chondroideus circ. $\frac{1}{3}$ diametri ramorum occupans. Apothecia numerosa, ramis lateraliter insidentia, sessilia, minuta, 0.5–1.0 (–1.3) mm. lata, concava vel fere plana, margine thallino prominulo, tenui, integro aut obsolete crenato, disco pallido, pruinoso, flavido-albicanti, opaco. Sporae ellipsoideae, simplices, incoloratae, longit. 8–10 μ, crassit. 4.5–5.0 μ. — Medulla

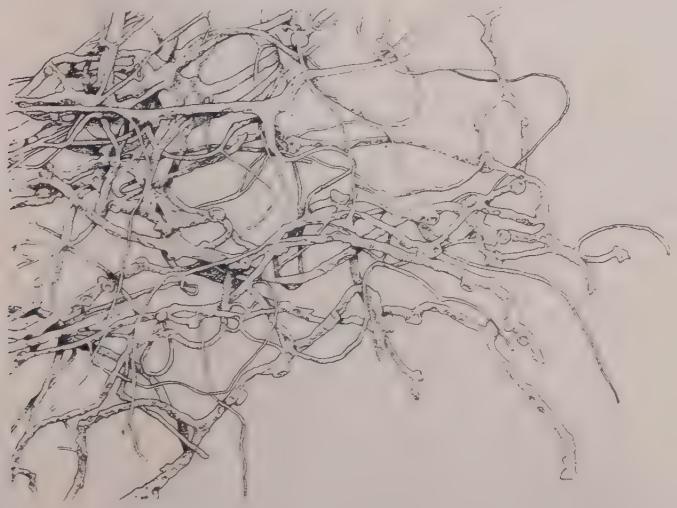


Fig. 30. *Usnea kuehnemannii* Mot. Part of the isotype-specimen in Farlow Herb. ($\times$ 3).

KHO– , $CaCl_2O_2$– , PD– .— Affinis, ut videtur, speciei austroafricanae *U. primitivae* Mot. Habitu pendulo et apotheciis lateralibus subgeneri *Protousneae* similis, vero autem propter discum pallidum apotheciorum in subgen. *Euusneam* locanda.— Arboricola in Argentina, Patagonia, Neuquén, haud procul e lacu Quillén, socia *Usneae* (*Protousneae*) *poeppigii*: O. Kühnemann, 1943, no. 796 pr. p.

Thallus 11–20 cm. long, pendulous, slender, moderately branched, somewhat elastic, dark stramineous or brownish-yellowish, matt or subnitid; main branches 0.5–0.8 mm. thick, partly smoothly terete, partly foveolate-scrobiculate with angulose ridges; terminal branches smooth, terete, finely capillary. Soredia present on many of the finer branches, minute, farinose, scattered or in places ± confluent, not prominent, yellow-whitish. Apothecia numerous, laterally sessile on the branches, minute, 0.5–1.0 (–1.3) mm. diam., concave to almost plane, with prominent, thin, entire or obsoletely crenate thalline margin and pale, yellow-whitish-pruinose, matt disc. Spores ellipsoid, simple, colorless, 8–10 × 4.5–5.0 μ.

Related apparently to *U. primitiva* Mot., a South African species described by Motyka in *Lich. Gen. Usnea Stud. Monogr.*, 627: 1936–1938. These two species approach the sect. *Protousnea* in their pendulous habit and lateral apothecia, but are placed in the subgenus *Euusnea* on account of the pale apothecial discs. The material was identified as a new species and named by Dr. J. Motyka.

Type in Herb. J. Motyka, Lublin, Poland; isotypes in Herb. Admin. Parques Nacionales, Avda. Santa Fe 690, Buenos Aires, and Herb. Mus. Nat. Canada, Ottawa.

Buellia (Eubuellia) **tephrodes** M. Lamb (n. sp.)

Thallus effusus, maculas orbiculares aut irregulariter confluentes formans, obscure cinereus (madefactus pallide fuscescens), opacus, areolatus vel verrucoso-areolatus, crassitudine mediocri, areolis vulgo tumidis, 0.2–0.3 mm. latis. Hypothallus indistinctus aut obsoletus. Apothecia copiosa, dispersa, sessilia, rotundata, 0.5–0.8 mm.

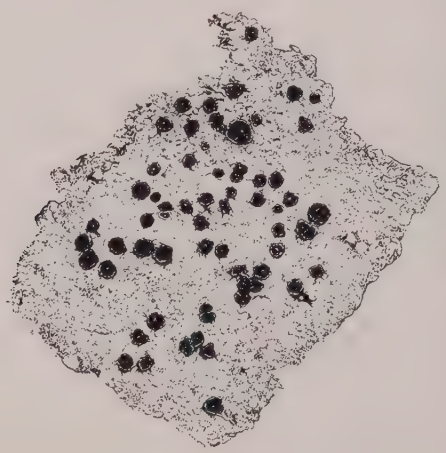


Fig. 31. *Buellia tephrodes* M. Lamb. The type-specimen (× 4).

lata, nigra (aut passim fusconigra), opaca, nuda, diu aut persistenter plana et margine concolori mediocri integro praedita, rarius demum convexo-immarginata (haud alte convexa), disco subtiliter scabrido. Excipulum laterale, cum hypothecio obscure fuscum aut fusconigrescens. Hymenium 90–100 μ altum, in summa parte obscure

fuscum, caeterum decolor, haud oleoso-inspersum; paraphyses jam in aqua facile liberae, apicibus fusco-capitatae. Sporae (6–) 8nae, latiuscule oblongo-ellipsoideae, vulgo rectae, fuscae, 1-septatae, 18–24 (–27) × (8–) 10–13 μ, ad septum haud vel vix constrictae, septo tenui aut parum incrassato. — Thallus neque KHO, nec $CaCl_2O_2$, nec PD reagens; medulla pro maj. parte I– , passim parce I + caerulescens. — Australiensi *B. arenariae* Müll. Arg. accedit, a qua thallo obscuriore, magis verrucoso-areolato, hymenio altiori etc. recedit. *B. macrospora* Müll. Arg., item e Australia, apotheciis cito valde convexis et nitidis et sporis longioribus et oligotocis differt. — Ad saxa granitoidea in Argentina, Patagonia, Río Negro, insula Victoria in lacu Nahuel Huapí, non procul e littore, inter *Lecideam albidocinerellam* (Vain.) Vain., *Caloplacam pyraceam* (Ach.) Th. Fr., *Candelariellam vitellinam* (Ehrh.) Müll. Arg. et *Rhizocarpon disporum* (Naeg.) Müll. Arg. sat abundanter proveniens: M. Lamb, 1950, nos. 5854 pr. p., 5855 pr. p. (typus speciei).

Description of the type-specimen (*M. Lamb no. 5855 pr. p.*): thallus effuse, without any trace of effiguration at periphery, forming ± orbicular or irregularly confluent patches 1–2 cm. diam. among other crustaceous lichens. No black hypothallus developed. Thallus dark ash-gray, becoming pale brownish when moistened, matt, 0.2–0.3 mm. thick, composed of crowded, plane to usually tumid-verrucose, irregularly angulose or rounded areolae 0.2–0.3 mm. diam. No isidia or soredia. Thallus KHO– (also under microscope), $CaCl_2O_2$– , PD– , in section covered by a ± developed, brown cortical layer up to 12 μ thick of indistinct gelified structure (in KHO more distinct, of cells 3–5 μ diam. with very thin brown walls). Medulla colorless and clear in section (white macroscopically), for the most part I– , but here and there a few of the hyphae stained violet-blue by Iodine. Apothecia sessile on thallus, well constricted at base, round, 0.5–0.8 mm. diam., numerous, scattered or occasionally two contiguous, black or sometimes brownish-black, matt, not pruinose, for a long time or persistently plane with moderate, entire proper margin, finally sometimes becoming ± convex and immarginate, but not strongly convex. Disc minutely scabrid, rarely umbonate in the center.

Excipulum developed at sides only, but reaching some way down on underside of apothecium; 60–80 μ thick, dark brown in section, more brown-blackish in outermost 5–10 μ, rather grossly pseudoparenchymatic, with ± rounded, isodiametric or slightly radially elongated cells 4.5–6.5 μ diam., their dark brown walls 0.6–1.0 μ thick. Hypothecium lentiform (plano-convex), up to 90 μ deep, dark brown or brown-blackish in lower half to two-thirds, paler brown in upper subhymenial part; distinct from the excipulum which encloses it at the sides; of ± cellular structure with cells up to 5 μ diam.; ± sharply delimited at base, or sometimes forming a ± distinct brownish stipe running down into the thallus tissue. Hymenium 90–100 μ high, somewhat abruptly dark brown or brown-blackish in uppermost 8–12 μ (the epithecial surface uneven), otherwise perfectly clear and hyaline (not inspersed with droplets, without any aeruginose tinge), with Iodine staining blue then dark aeruginose. Paraphyses discrete in water, 1.5–2.5 μ thick, simple or sparingly branched, not articulated except near the tips, which are clavate-capitate up to 4–5 μ and brown-pigmented. Asci clavate, 60–75 × 12–20 μ. Spores 6–8 in ascus, biseriate or irregularly overlapping, broadly oblong-ellipsoid, straight or occasionally bean-shaped, not or hardly constricted at septum, constantly 1-septate, the walls thin (about 0.6 μ), the septum somewhat thicker (1.0–1.5 μ); persistently brown (not becoming blackish or opaque), smooth-walled or finally with the wall extremely subtly granulate-scabrose (this visible only under oil-immersion); 18–22 (–27) × 11–13 μ. Sections of apothecia unchanged in color by KHO and HNO_3.

Symbiotic algae protococcoid, bright green, globose, separable, 12–19 μ diam., thin-walled.

A similar type of thallus, with brown-tipped cortical hyphae but appearing gray or whitish on account of the outermost amorphous layer, is found also in some other species, e.g. *B. notabilis* Lynge.

B. tephrodes appears to come closest to the Australian *B. arenaria* Müll. Arg. The

type-specimen of the latter was reexamined (see revision below), and it was found to differ from the present species chiefly in the lighter (whitish or cream-colored) thallus without brown-celled cortex, the lower and slightly inspersed hymenium, the thicker hypothecium, the less distinctly cellular excipulum, the somewhat narrower spores, and the more intense and uniform Iodine reaction of the medullary hyphae.

Occurring in the Isla Victoria on granitic rocks at the shore of Lake Nahuel Huapí, about 4 m. above the water level, associated with *Lecidea albidocinerella* (Vain.) Vain., *Caloplaca pyracea* (Ach.) Th. Fr., *Candelariella vitellina* (Ehrh.) Müll. Arg. and *Rhizocarpon disporum* (Naeg.) Müll. Arg.

Type in Herb. Mus. Nat. Canada, Ottawa.

Buellia arenaria Müll. Arg.

in *Bull. Herb. Boissier*, Vol. I, 52: 1893.

The following is a revision of the type-specimen from Australia, Victoria, near Lorne, coll. F. R. M. Wilson, 1892 (no. 1044), in Herb. Müller Arg., Herb. Boissier, Geneva:

On sandstone rock. Thallus apparently effuse and widespread, sordid whitish or cream-colored, matt, not changing color when moistened, areolate, the areolae 0.2–0.5 mm. diam., mostly contiguous but in places ± dispersed with the bare stone showing in between; irregular in outline, obtusely angulose or ± rounded, plane to slightly convex. No isidia or soredia. No distinct dark hypothallus developed. Thallus externally and internally KHO– , $CaCl_2O_2$– , PD– ; medullary hyphae I + intense violet-blue. The thallus has no cortical layer of brown cells as in *B. tephrodes* M. Lamb. Symbiotic algae protococcoid, now very pale green, globose, thin-walled, easily separable, 8–13 μ diam. Apothecia fairly numerous, scattered, sessile on or between the areolae, round, moderately constricted at base, 0.3–0.7 mm. diam., entirely black, not pruinose, matt (only the margin sometimes shiny where rubbed), persistently ± plane with distinct, slightly prominent, moderate, entire proper margin.

Excipulum lateral, 35–75 μ thick, densely dark brown or brown-blackish, confluent with the concolorous hypothecium. Hypothecium thick, up to 200–300 μ deep in center, densely dark brown or brown-blackish, paler brown at the base where it penetrates downwards into the thallus tissue. The structure of these very dark apothecial tissues can be seen only in very thin sections; the excipulum is composed of short, rounded, isodiametric or slightly radially elongated cells 4–5 μ diam., ± indistinct on account of the dense brown pigment, which is especially thick in the outermost 25–30 μ. The hypothecium is of more distinct cellular structure, with rounded or rectangular cells 4–5 μ wide, with brown walls up to 1 μ thick, for the most part obviously formed as cells of vertically parallel hyphae. Both excipulum and hypothecium are KHO– , HNO_3 + more reddish. Hymenium 60–75 μ high, colorless (or faint brownish in thicker sections), unevenly dark brown in uppermost part, slightly guttulate-inspersed with some oil-droplets in the lower part; without any aeruginose tinge. Paraphyses in some mucilage but discrete in water, 1–2 μ thick, simple or sparingly branched, not articulated, at tips clavate-capitate to 4.0–4.5 μ and there unevenly capped with dark brown pigment. Asci clavate, 45–55 × 10–17 μ, with gelatinous wall 1.0–1.5 μ thick at sides and 3–10 μ thick at apex. Spores 5–6 (–8) in ascus, brown to dark brown (not becoming blackish or opaque), ellipsoid to oblong-ellipsoid, 1-septate, often ± constricted at the septum, straight, (14–) 16–22 × (8–) 9–11 μ; the cells of equal size, the spore-wall thin, less than 1 μ, smooth, the septum often slightly thicker (1.0–1.5 μ), but sometimes thin like the spore-wall. Hymenium with Iodine blue then greenish-blue.

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THE LICHEN GENUS BUELLIA IN THE WEST INDIES

HENRY A. IMSHAUG [1]

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INTRODUCTION

This study of the West Indian species of *Buellia* follows a similar study of the North American species which was the subject of my doctoral thesis and was "published" only in the form of microfilm (Imshaug, 1952). The material in this thesis is, however, being prepared for regular publication in a revised form.

A separate paper is being published on the morphology and anatomy of the genus. The present paper is, therefore, one of a series of regional re-

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visions which are intended to be used in conjunction with the paper on morphology and anatomy since it expresses my views on the taxonomy of the genus. The ultimate goal is the completion of a monograph of all the species of *Buellia*. It is hoped that the publication of regional revisions will stimulate further collecting and provide more material for the final monograph.

GEOGRAPHY AND CLIMATE

The West Indies are a group of islands enclosing the Caribbean Sea between SE North America and N South America. They lie between latitudes 10° and 25° N and longitudes 60° and 85° W. The islands are generally grouped in three divisions: GREATER ANTILLES including Cuba, Hispaniola (Haiti and Dominican Republic), Jamaica, and Puerto Rico; LESSER ANTILLES including Virgin Islands, Windward Islands, Leeward Islands, and the islands in the S Caribbean Sea north of Venezuela; BAHAMA ISLANDS. Included also in this study are a few islands (Swan Islands, San Andrés, and Providencia) in the Caribbean Sea off the coast of Central America.

The largest island is Cuba with an area of 44,164 sq. miles. The remaining islands, listed according to size, are Hispaniola (29,979 sq. miles), Jamaica (4,450 sq. miles), Puerto Rico (3,435 sq. miles), Trinidad (1,862 sq. miles), Guadeloupe (619 sq. miles), Martinique (380 sq. miles), Dominica (304 sq. miles), St. Lucia (233 sq. miles), Barbados (166 sq. miles), St. Vincent (130 sq. miles), Grenada (120 sq. miles) and Antigua (108 sq. miles). All the other islands, except some of the Bahama Islands, have an area of less than 100 sq. miles.

Many of the islands are mountainous, either of volcanic origin as in the Lesser Antilles, or as a result of uplifting accompanied by folding, thrusting, and faulting as in the Greater Antilles. The Bahama Islands, however, are of very low relief, rising to a maximum elevation of 400 ft. on Cat Island. The outliers in the Lesser Antilles are also of low relief, varying from hilly to practically flat. These latter islands are composed principally of sedimentary rocks which lie horizontally or are somewhat tilted. Elevations of about 1000 feet are attained on these outliers.

The highest elevation in the West Indies, 10300 feet, is found in Hispaniola. Blue Mountain Peak, in Jamaica, is the next highest mountain, with an elevation of 7402 ft. The highest elevations in Cuba and Puerto Rico are, respectively, 6560 ft. and 4398 ft. In the Lesser Antilles Guadeloupe has the highest elevation with a dormant volcano of 4800 ft.

TEMPERATURE[2]: The temperature throughout the West Indies is rather uniform at sea level. The mean annual temperature (below 500 ft.) varies from 74°–81° F. The mean annual range of temperatures is from 3°–7°F, except in Cuba and the Bahamas where the mean range is

[2] The climatological data were obtained mostly from W. W. Reed, Climatolcgical data for the West Indian Islands, Monthly Weather Review 54(4): 133–160. 1926. It has been supplemented, however, with more recent local reports.

greater (8°–11° F). Extreme temperatures are from 51°–101° F except in Cuba where the extremes vary from 40°–104° F. The temperature, however, decreases with an increase in elevation. In Jamaica, for example, there is a drop of 1° F for each 320 ft. rise in altitude. A recording of the elevation of the collection is, therefore, an indication of the temperature.

The highest elevation for a *Buellia* in the West Indies is on Blue Mountain Peak (7402 ft.) in Jamaica. The mean annual temperature here is 56° F and frost has not been recorded. Higher elevations occur in Hispaniola but meteorological data are not available.

PRECIPITATION: Precipitation is entirely in the form of rain, except for an occasional hail storm. The minimum yearly mean for the region is approximately 20 inches, in Hispaniola, while 252 inches, in Jamaica, represents the maximum yearly mean. The characteristic feature of the mountainous islands is the remarkable difference in the amount of rainfall received on windward and leeward exposures and in low and elevated areas. Striking contrasts can be found between stations separated by only a few miles. The greatest difference occurs in Jamaica where there is a gradient of 190 inches (mean annual rainfall) in a distance of 30 miles. An even more striking example is recorded for Dominica with a change from 78 inches to 185 inches (mean annual rainfall) occurring in a distance of only three miles. In general the low islands are rather arid while the mountainous islands have a wet windward side and a dry leeward side. The opposite condition may, however, prevail if the mountains are on the leeward side as in Grenada.

The mean annual rainfalls for the driest and wettest parts of the main islands included in this study follow. There may be drier or wetter parts on the islands, but if so there are no meteorological data available for them.

Bahamas: 46 inches is the yearly mean at Nassau.
Cuba: 28 to 79 inches.
Isle of Pines: 71 inches is the yearly mean at Nueva Gerona.
Jamaica: 27 to 252 inches.
Hispaniola: 20 to 103 inches.
Puerto Rico: 36 to 135 inches.
Virgin Islands: 41 to 46 inches are the yearly means at Charlotte Amalie (St. Thomas) and Christiansted (St. Croix), respectively.
Guadeloupe: 50 to 156 inches.
Dominica: 70 to 193 inches.
Martinique: 45 to 120 inches.
St. Vincent: 70 to 91 inches.
Grenada: 39 to 147 inches.
Trinidad: 45 to 108 inches (but possibly as high as 200 inches on summit of Aripo).

EVAPORATION: Evaporation is influenced by temperature, vapor pressure, and wind velocity under 20 miles per hour. These are relatively constant in the West Indies. Data are available from localities near sea

level in Jamaica, Puerto Rico, and St. Croix (Ray, 1931). They show that evaporation exceeds precipitation throughout the year, except in the height of the rainy season. This excessive evaporation is largely the result of the steady trade winds throughout the year and the long daily periods of sunshine and high temperature. More rain is, therefore, needed to support a given type of vegetation than in cooler regions.

ECOLOGY

Local usage speaks of "dry belt," "middle belt," and "mountain belt" climates. These climatic zones have also been used in referring to the vegetation. Stehlé (1945) thus uses the terms "forêt xérophile," "forêt mésophile," and "forêt hygrophile" for the vegetation in the dry, middle, and mountain belts respectively. As pointed out by Beard (1949) this is an unsatisfactory basis for an ecological classification of the vegetation as a whole. Attention should be directed on the physiognomy of the forest. The present writer believes, in addition, that more attention should be given to the nonvascular plants and their use in a life-form classification. A purely floristic system is of little value in the tropics (Richards, 1952).

There is, however, very little natural vegetation left in the West Indies. Almost all of the available land has been used at one time or another for the cultivation of sugar cane. The practice of shifting cultivation has further destroyed much of the natural vegetation on slopes too steep for sugar cane. The genus *Buellia*, however, is not limited to the natural vegetation and may be collected wherever trees are cultivated and wherever rock outcroppings occur. Although the bark of many tropical trees is too smooth to support many lichens the common Coconut and Mango trees provide an excellent habitat. There are no terricolous *Buelliae* in the West Indies. Although I could find no *Buelliae* on the various limestones in Jamaica there is a collection of *B. dejungens* from limestone in Cuba, and a collection of *B. posthabita* from limestone in Puerto Rico.

It appears best to classify the species as regards their moisture requirements. In Jamaica the lichens can be readily grouped into three classes. This was done by plotting the annual mean rainfalls of 317 Jamaican weather stations on topographic maps and estimating the annual mean rainfall of each collection locality. The three classes are called xerophytic, mesophytic, and hygrophytic and are used in reference to the three main climatic belts. As Beard (1949, p. 14) points out "all climatic changes are a gradual progression and human classification is entirely arbitrary." For the distribution of lichens, however, this is a very convenient and practical classification.

Xerophytic lichens are found in areas receiving a mean of 40–60 inches of rainfall per year. Mesophytic lichens are found in areas receiving 60–100 inches. Hygrophytic lichens are those found only in areas with more than 100 inches of rain annually. Some species are able to grow under both xerophytic and mesophytic conditions. The rainfall figures given for the three classes were developed for Jamaica but should apply generally

throughout the West Indies where temperature and evaporation are similar. In the Bahamas and parts of Cuba, however, the figures would probably be lower.

An especial effort was made to collect lichens in the most arid parts of Jamaica. That is, in the Thorn Scrub Woodland and Cactus-Thorn Scrub vegetation of the south coast and on the outlying cays.[3] This region has a mean annual rainfall of less than 40 inches, with a minimum recorded yearly mean of 27 inches. Not a single species of *Buellia* was found in this extremely arid region.

In Jamaica the species are classified as follows:

XEROPHYTIC: *B. leucomela* and *B. yaucoensis.*

XEROPHYTIC-MESOPHYTIC: *B. efflorescens*, *B. gerontoides*, and *B. modesta.*

MESOPHYTIC: *B. bahiana*, *B. catasema*, *B. glaziouana*, *B. lauricassiae*, *B. melanochlora*, *B. proximata*, *B. subsensitiva*, and *B. trachyspora.*

HYGROPHYTIC: *B. atrofuscata*, *B. callispora*, *B. glaucotheca*, *B. jamaicensis*, *B. placodiomorphoides*, *B. posthabita*, *B. remensa*, and *B. rufofuscescens.*

In Grenada only six species were collected, *B. catasema*, *B. efflorescens*, *B. gerontoides*, *B. placodiomorpha*, *B. posthabita*, and *B. remensa.* All of these must be classed as mesophytic. The most arid part of Grenada (Point Saline) has a 19 year (broken) average of 49 inches mean annual rainfall. This figure is exceedingly variable throughout the years, ranging from 22 inches to 92 inches. It appears doubtful if a true dry belt climate occurs in Grenada because of the frequency of years with means exceeding 60 inches. No *Buellia* was found in the mountain belt climate of Grenada.

For the other islands an attempt has been made to determine the climatic belt the species was collected in from the locality data given on the herbarium label. This was done through the use of the rainfall maps published for the various islands. The results are given under the individual species in the taxonomic section.

DISTRIBUTION

The West Indies have been visited by a number of lichenologists. C. C. Plitt and C. E. Cummings both collected in the Blue Mountains of Jamaica, and Bruce Fink spent two months collecting in Puerto Rico. The only species reported in the literature from Fink's collections are some new species but Fink (1918) has written a general account of his sojourn in Puerto Rico. The entire collection has been prepared for publication by Joyce Hedrick Jones as a portion of Volume VII, Part 4 (unpublished) of the Scientific Survey of Porto Rico and the Virgin Islands. The present writer has made extensive collections in Jamaica and Grenada.

[3] For a description of the vegetation of Jamaica see Asprey and Robbins, 1953.

There are, in addition, a number of other collectors who, although not specialists on lichens, have collected many lichens and their collections show a considerable field knowledge of the group. Britton and his associates have collected very extensively in the Bahama Islands, Isle of Pines (off Cuba), Puerto Rico, and the Virgin Islands.

As a result of all the collecting up to the present time it can be said that the lichen floras of the Bahamas, Cuba, Jamaica, Puerto Rico, Virgin Islands, and Grenada are well represented in herbaria. Guadeloupe, Dominica, Martinique, St. Vincent, and Trinidad are also represented, but less completely. The remaining islands are represented by few, if any, collections. It is most unfortunate that so little material is available from Hispaniola.

ENVIRONMENTAL FACTORS: The distribution of the species of Buellia in the West Indies is governed both by environmental and historic factors. Thus a hygrophytic species would be expected to occur only where the annual rainfall is in excess of 100 inches (mean annual). Not all islands can supply this condition. Two species, *B. atrofuscata* and *B. rufofuscescens*, formerly known only from Brazil have been found in Jamaica in a locality with over 150 inches of rainfall. The only other island with comparative rainfall is Dominica and, unfortunately, the collections from this island are rather meager. On the other hand, some islands (e.g., Grenada) may not have the arid conditions necessary for the xerophytic species. *Buellia modesta*, for example, does not seem to occur on this island.

The temperature, although fairly constant near sea level for most of the region under consideration, appears to differ enough in Cuba and the Bahamas to be considered as a factor. These islands, or portions of them, are usually excluded from the tropical part of Middle America. Four species are known from the Bahamas, *B. bahiana*, *B. catasema*, *B. gerontoides*, and *B. modesta*. All four of these are found in Jamaica where they are classed as mesophytic or xerophytic-mesophytic. It is probable that in a cooler climate the moisture requirements as expressed by annual mean rainfall would be less. Thus some species common to both the Bahamas and Jamaica would require less annual rainfall in the former islands. The terms xerophytic, mesophytic, and hygrophytic actually represent a precipitation/evaporation index rather than mean annual rainfall alone. Evaporation figures, however, are not generally available.

Buellia callispora is found in Jamaica in areas receiving from 80 inches to 200 (or more) inches of rain. The only other West Indian collection is from Guadeloupe. This species is, however, found along the coast of eastern North America as far north as Latitude 35° N. and in South America, along the eastern coast as far south as Latitude 35° S. Temperature would appear to be the limiting factor, as well as moisture, in this case.

HISTORIC FACTORS: Theories on migration within the West Indies have largely been based upon continuous land connections. An excellent review of the historical geology of the region is given by Schuchert (1935).

The Greater Antilles seem never to have been connected by dry land to North America. Likewise, there is no evidence that the Lesser Antilles were ever connected with South America.[4] Furthermore, there is no evidence that there was a continuous land connection from the Greater Antilles to Grenada. Two Central American – Greater Antillean land bridges have been postulated, one from the Honduran peninsula to the Greater Antilles and one from the Yucatan peninsula to Cuba. Schuchert (1935) recognizes only the first one. The islands in the Greater Antilles appear to have been connected at one time or another and this land bridge extended as far east as the Virgin Islands or, possibly, Antigua.[5]

It is apparent, then, that the distribution of many species is the result of long distance migration. The corticolous species of *Buellia* are on the whole widely distributed, with only 2 out of 17 endemic to the West Indies. As for the saxicolous species, however, 8 out of 10 (*B. dispersula* is not considered West Indian) are endemic to the West Indies, with all but 3 limited to one island. All 8 endemics are, however, limited to the Greater Antilles and Virgin Islands which were at one time connected to Central America. Of the 3 endemics which are found on more than one island: *B. trachyspora* is common to all the Greater Antilles[6] and Virgin Islands; *B. dejungens* has apparently bypassed Jamaica but is found on all the other Greater Antilles and Virgin Islands; *B. prospersa* is limited to the Virgin Islands.

It seems that long distance migration must account for the wider distribution of many of the corticolous species. Long distance migration is apparently not so effective in the dispersal of saxicolous species. A suitable habitat for saxicolous species is not so common as a suitable habitat for corticolous species. What rock is found in the West Indies is frequently protected by the canopy (or canopies) of the forest. Many of the rocks also disintegrate very rapidly.

Two saxicolous species, however, are widely distributed. These are *B. glaziouana* and *B. posthabita*. The absence of *B. glaziouana* from the Windward Islands and Cuba indicate that this species, widely distributed in SE United States, Central America and South America entered the West Indies by the former land connection with Central America. *Buellia posthabita* is the most widely distributed saxicolous species within the West Indies. It is known from South America but not from North America, nor from Central America. It is the only definite saxicolous example of long distance migration.

Many of the corticolous species are known not only from North America, Central America, and South America but also from the Pacific

[4] Trinidad is strictly speaking not to be considered a part of the West Indies since it is geologically and biologically a part of the South American continent. It is included in this study merely as a matter of convenience.

[5] See figs. 5 & 6 in Beard (1949) which outline the conjectural geography of the Lesser Antilles in early Miocene and early Pliocene times.

[6] Where a species is found on both Cuba and Puerto Rico it is assumed that it also occurs on Hispaniola.

Islands and tropical Asia. Since this genus has not yet been critically studied outside the Western Hemisphere no attempt will be made to discuss the broader aspects of their distribution at this time.

The two corticolous species which are endemic to the West Indies are *B. placodiomorphoides* and *B. yaucoensis*. Like the saxicolous, endemic species, these are limited to the Greater Antilles. *Buellia gerontoides*, although not endemic to the West Indies is nevertheless limited in its distribution to low elevations in the Caribbean area.

The distribution of the West Indian species of *Buellia* is summarized in Table I.

TAXONOMIC SECTION

HERBARIA CONSULTED

The symbols used are those in the Index Herbariorum.

BM — British Museum (Natural History), London, Great Britain.
BPI — Plitt Herbarium in Bureau of Plant Industry, Beltsville, Maryland, U. S. A.
C — Botanical Museum & Herbarium, Copenhagen, Denmark.
F — Chicago Natural History Museum, Chicago, Illinois, U. S. A.
FH — Farlow Herbarium, Harvard University, Cambridge, Massachusetts, U. S. A.
G — Müller Arg. Herbarium in Conservatoire et Jardin botaniques, Genève, Switzerland.
H — Nylander Herbarium in Botanical Museum, Helsinki, Finland.
Imsh — Private herbarium of author, H. A. Imshaug.
M — Krempelhuber Herbarium in Botanische Staatssammlung, München, Germany.
MICH — University of Michigan, Ann Arbor, Michigan, U. S. A.
MO — Missouri Botanical Garden, St. Louis, Missouri, U. S. A.
NY — New York Botanical Garden, New York, New York, U. S. A.
PC — Laboratoire de Cryptogamie, Muséum National d'Histoire Naturelle, Paris, France.
PH — Academy of Natural Sciences, Philadelphia, Pennsylvania, U. S. A.
TUR — Vainio Herbarium in Botanical Institute of the University, Turku, Abo, Finland.
US — U. S. National Museum, Smithsonian Institution, Washington, D. C., U. S. A.

KEY TO SPECIES

A. SAXICOLOUS SPECIES

1. Spores incompletely 3-septate (secondary septa not completely formed) ..... *B. jamaicensis*
1. Spores 1-septate.
  2. Spore wall or septum thickened, either evenly or unevenly.
    3. Spore wall thin but septum thickened.
      4. Thallus thin & continuous, KOH — ..... *B. prospersa*
      4. Thallus of large verrucae, occasionally sublobate, KOH + (red, crystals) ..... *B. boergesenii*
    3. Spore wall thickened; spores not polarilocular.
      5. Hypothecium and stipes colorless; spores mischoblastiomorph ..... *B. posthabita*
      5. Hypothecium and stipes brown.

6. Thallus thin & continuous, becoming rimose-areolate; stipes & exciple KOH + (purple out in solution); spore wall ± evenly thickened; no oil drops in hymenium ..... *B. dejungens*
6. Thallus composed of granules, scattered or confluent; stipes & exciple KOH − ; spores mischoblastiomorph; oil drops in hymenium ..... *B. subdispersula*
Granules cinereous ..... var. *subdispersula*
Granules yellow ..... var. *flavogranulosa*

2. Spore wall and septum thin and even.
7. Spore surface prominently verrucose ..... *B. trachyspora*
7. Spore surface smooth.
8. Thallus continuous, becoming rimulose or rimose-areolate. *B. glaziouana*
Thallus section KOH −
Thallus yellowish ..... var. *glaziouana*
Thallus cinereous or white ..... var. *poliocheila*
Thallus section KOH + (red, crystals) ..... var. *sensitiva*
8. Thallus not continuous.
9. Epithecium green; hypothallus continuous, gray or dark cinereous; thallus of thin, scattered, cinereous areoles, KOH + (red, crystals) ..... *B. subsensitiva*
9. Epithecium brown; hypothallus consists of a few scattered black specks.
10. Thallus dispersed areolate in center, radiate-laciniate at periphery, brown, KOH − ..... *B. brittoniae*
10. Thallus consists of scattered, small, cinereous areoles, freq. narrow & elongated, KOH + (red, crystals) ..... *B. dispersula*

B. Corticolous and Lignicolous Species

1. Spores 3-septate.
2. Exciple brown; hypothecium KOH − ; spores 21–26 × 8–10 μ ..... *B. proximata*
2. Exciple pallid; hypothecium KOH + (red, crystals); spores 17–21 × 6–9 μ ..... *B. lauricassiae*
1. Spores 1-septate.
3. Spore wall or septum thickened, either evenly or unevenly.
4. Hymenium inspersed with oil drops.
5. Spores mischoblastiomorph ..... *B. atrofuscata*
5. Spores not mischoblastiomorph.
6. Epithecium green, KOH + (violet); thallus and hypothecium KOH + (red, crystals); spores 14–19 × 6–9μ ..... *B. bahiana*
6. Epithecium yellow-orange, KOH − ; thallus and hypothecium KOH − ; spores 29–42 × 14–21 μ .. *B. callispora*
4. Hymenium not inspersed with oil drops.
7. Spore wall not thickened at apex but thickened in center (spores ± polarilocular).
8. Spores 14–18 × 6–9 μ; exciple brown ..... *B. placodiomorpha*
8. Spores 21–28 × 9–10 μ; exciple pallid and with oil drops ..... *B. placodiomorphoides*
7. Spore wall ± evenly thickened, leaving one small spherical sporoblast in each cell.

9. Disk of apothecium naked; epithecium brown, KOH — ; thallus KOH — ; exciple KOH + (red-violet out in solution) ..... *B. yaucoensis*
9. Disk of apothecium ± white pruinose; epithecium green, KOH + (violet); thallus KOH + (red, crystals); exciple KOH — ..... *B. remensa*

3. Walls of spores thin & uniform in thickness.
10. Asci polysporous ..... *B. efflorescens* var. *diminutiva*

10. Asci octosporus.
11. Disk of apothecium pruinose.[7]
12. Pruina red or red-brown; exciple KOH + (red-violet out in solution) ..... *B. rufofuscescens*
12. Pruina white or yellow-green.
13. Pruina white; thallus & hypothecium KOH + (red, crystals)
14. Epithecium brown, KOH — ; spores 18–28 × 7–9 μ ..... *B. glaucotheca*
14. Epithecium green, KOH + (violet); spores 13–17 × 6–8 μ ..... *B. remensa*
13. Pruina yellow or yellow-green.
15. Spores 12–17 × 5–7 μ; hypothecium KOH + (red, crystals); epithecium KOH — ..... *B. gerontoides*
15. Spores 19–28 × 8–12 μ; hypothecium KOH + (red out, but no crystals); epithecium KOH + (layer of yellow granules) ..... *B. melanochlora*
11. Disk of apothecium naked.
16. Hymenium inspersed with oil drops; epithecium green, KOH + (violet) ..... *B. bahiana*
16. Hymenium not inspersed with oil drops.
17. Spores verruculose ..... *B. leucomela*
17. Spores smooth.
18. Thallus soraliate, KOH — ; exciple brown; spores 11–14 × 5–7 μ ..... *B. efflorescens*
18. Thallus not soraliate.
19. Exciple pallid; hypothecium & thallus KOH + (red, crystals); thallus continuous to ± rimose ..... *B. modesta*
19. Exciple brown; hypothecium & thallus KOH — ; thallus granulose ..... *B. catasema*
Thallus not red inside ..... var. *catasema*
Thallus red inside ..... var. *sanguinariella*

Buellia atrofuscata Wainio, Étude Lich.

Brésil 1: 169. 1890.

Buellia conformis Wainio, Étude Lich. Brésil 1: 168. 1890.

Type collections: *Buellia atrofuscata* — "Ad terram humosam in Carassa (circ. 1500 metr. s. m.) in civ. Minarum, n. 1416." (Brazil) Holotype in TUR (Vainio Herb.); isotype in FH.

Buellia conformis — "Ad corticem arboris prope Sitio (1000 metr. s. m.) in civ. Minarum, n. 1093." (Brazil) Holotype in TUR (Vainio Herb.); isotype in FH.

HYPOTHALLUS not seen. THALLUS scant, occasionally absent. APOTHECIA

[7] Note that the pruina may be scant, in which case it is best seen when the disk is moistened with water.

0.2–0.4 mm. across, scattered. Disk black, dull, naked, plane to somewhat convex. Margin thin and concolorous.

Hypothecium and stipes brown, confluent. Exciple thin and concolorous. Hymenium 85–105 μ thick, colorless but inspersed with small oil drops; paraphyses forming a brown epithecium. Spores 8 in ascus, mischoblastiomorph, fumose to brown, 18–24 × 10–12 μ.

Chemical Reactions: Apothecial tissues KOH — ; thallus section KOH — .

A hygrophytic, corticolous and lignicolous species known in the West Indies only from the Blue Mountains of Jamaica.

Material seen: JAMAICA — The Triangle, *Cummings 312*, Feb. 28, 1905 (FH); *Cummings 126*, March 1905 (FH); hut at Murdocks Gap, 3300 ft., *Imshaug 15299a*, March 19, 1953 (Imsh).

Wainio used two names for this species. *Buellia conformis* was described from corticolous material and *B. atrofuscata* was described from material on debris. Although *B. conformis* has "page priority," Malme (1927) used the epithet *atrofuscata* for this species. It should also be noted that the excipular differences apparent in Wainio's descriptions do not exist.

Buellia bahiana Malme, Ark. Bot.

21A(14): 17. 1927.

Buellia eckfeldtiana Steiner in Magn. & Zahlbr. Ark. Bot. 32A(2): 51. 1945.

Type collections: *Buellia bahiana* — Collected on bark by Malme at Rio Vermelho, Bahia, Brazil. Three numbers (12, 15, & 35) are cited but none is designated as holotype. I have seen only one of these in MO.

Buellia eckfeldtiana — Collected on bark by Eckfeldt and Bailey at Hilo, Hawaii (Hawaiian Islands). Holotype in W (not seen).

HYPOTHALLUS not seen except as black delimiting line around thallus. THALLUS glaucous-cinereous (occasionally somewhat sulphureous), continuous to somewhat rimulose with surface smooth or ± verrucose. Well-developed thalli are rather thick and rimose-areolate, the areoles composed of many verrucae. APOTHECIA scattered, superficial, constricted at base, 0.3–0.7 mm. across, occasionally conglomerate. Disk black, naked, dull, plane to slightly convex. Margin thin and concolorous, occasionally becoming wavy.

Hypothecium, stipes and exciple confluent, dark brown; stipes well developed to base of thallus. Hymenium 55–88 μ thick, colorless, inspersed with many oil drops; paraphyses forming a green epithecium. Apical cells of paraphyses only slightly enlarged and fusco-capitate. Spores 8 in ascus, pale fuscous, callisporoid, 14–19 × 6–9 μ.

Chemical Reactions: Epithecium KOH + (lavender); hypothecium and exciple KOH — ; thallus KOH + (red, crystals).

A mesophytic, corticolous species of wide distribution in tropical and subtropical regions. In addition to the West Indian material collections have been examined from Bermuda, United States (Florida), Central America, South America, and the Hawaiian Islands.

Material seen: BAHAMAS — New Providence, *Brace 9566*, Aug. 5, 1918 (NY).

CUBA — locality unknown, *Wright II 131* (US); locality unknown, *Wright II 130* (US); on *Cocothrinax*, La Cañada, Isle of Pines, *Britton, Britton & Wilson 14423a*, Feb. 16, 1916 (FH-Riddle); on *Cocothrinax*, La Cañada, Isle of Pines, *Britton, Britton & Wilson 14426*, Feb. 16, 1916 (FH-Riddle, NY); on *Colpothrinax*, San Pedro, Isle of Pines, *Britton & Wilson 14550 & 14549*, Feb. 12–March 22, 1916 (FH-Riddle, NY).

JAMAICA — Wareika House, summit of Long Mountain, 1350 ft., *Imshaug 13501*, Nov. 29, 1952 (Imsh); sea level, Long Bay, *Imshaug 15584, 15589 & 15597*, April 21, 1953 (Imsh); White River Bay, 30 ft., *Imshaug 15761a*, May 4, 1953 (Imsh); Hollymount, Mt. Diablo, 2750 ft., *Imshaug 14236*, Jan. 28, 1953 (Imsh).

PUERTO RICO — Manato, *Fink 2075*, Jan. 13, 1916 (FH).

ST. THOMAS — Crown, *Raunkiaer 421*, Nov. 31, 1905 (C); *Boergesen*, Jan. 1896 (C).

MARTINIQUE — Between Fort de France & Montmartre, *Evans 524*, Sept. 2, 1927 (FH & MO–70731).

This species is rather variable as regards some of its diagnostic characters and care must be used in ascertaining the presence or absence of a particular feature. For example, the KOH reaction of the thallus is frequently limited to scattered spots in the thallus. Also, the callisporoid appearance of the spores is not so apparent at first glance as it is in *B. callispora*. In doubtful cases allow section to stand awhile in KOH. Shadows of incipient secondary septation frequently appear even if definite callisporoid cells are not visible.

The greenish epithecium, presence of oil drops in the hymenium, dark brown exciple and smooth, continuous thallus are perhaps the most reliable characters.

Buellia boergesenii sp. nov.

Hypothallus nigricans, parum conspicuus, e maculis formatus minutissimus, dispersis. Thallus crassus aut mediocris, e verrucis formatus semiglobosis vel irregularibus, interdum sublobatis, dispersis, KOH sanguineorubens, solutione mox cristalla acicularia formante; hyphis J non coerulescentibus. Apothecia 0.3–0.5 mm. lata, basi constricta, disco plano, nigro, nudo aut cinereo-pruinoso, margine tenui, nigro. Hypothecium, stipes et excipulum fusconigricans, KOH sanguineo rubens, solutione mox cristalla acicularia formante. Hymenium 60 μ altum, haud oleoso-inspersum, superne fuligineum. Sporae 8:nae, fuscae, 1-septatae, septo crasso, membrana ceterum parum incrassata, 13–17 μ longae, 6–7 μ crassae. Specimen typicum in saxo, Cruz-Bay, insula St. John, legit F. Boergesen, Mar. 11, 1906. Holotypus in C conservatus.

HYPOTHALLUS consists of a few scattered black specks. THALLUS composed of large verrucae (0.25–0.50 mm. across) which become flattened and occasionally lobate. Verrucae tan, but usually covered with a light cinereous pruina. APOTHECIA 0.3–0.5 mm. across, superficial, constricted at the base. Disk black, frequently covered with a cinereous pruina, plane. Margin black, thin to moderate.

Hypothecium, stipes and exciple confluent, dark brown. Hymenium 60 μ thick, colorless, not inspersed with oil drops; paraphyses forming a brown epithecium. Apical cells of paraphyses enlarged and fusco-capitate. Spores 8 in ascus, brown, 1-septate with septum thickened to form a central isthmus, 13–17 $\times$ 6–7 μ. (See fig. 2I)

Chemical Reactions: Hypothecium and stipes KOH + (red, crystals); thallus section I − ; KOH + (red, crystals).

Known only from one collection on rock from the Virgin Islands.

Material seen: ST. JOHN — Cruz-Bay, on coastal rocks, *F. Boergesen*, March 11, 1906 (C-mixed with holotype of *Buellia orcularia*).

This collection was published by Wainio (1915) as *Buellia conspirans*. It differs from the holotype of *B. conspirans* (Herb. Nylander no. 10547), however, in the dark brown exciple and in the better developed thallus. The exciple in *B. conspirans* is pallid and the thallus consists of crowded, irregularly shaped granules.

Buellia brittoniae Riddle, Mycologia 15: 86. 1923.

Type collection: Collected on sandstone at La Cañada on Isle of Pines (off Cuba) in West Indies by N. L. Britton, E. G. Britton, & Percy Wilson, no. 14579, Feb. 16, 1916. Holotype in FH (Riddle Herb.); isotype in NY.

HYPOTHALLUS scant, consisting of a few scattered black specks. THALLUS consists of narrow (0.2–0.3 mm.), slightly convex, dark brown laciniae which grow centrifugally and fork repeatedly. At a distance of 0.6 to 1.3 mm. from the tips the laciniae become rimose and areoles develop. The original pattern of the laciniae is visible for a considerable distance but at the very center of the thallus the areoles

become very irregular and no definite pattern is discernible. APOTHECIA 0.3–0.5 mm. across, superficial, constricted at the base. Disk black, dull, rather scabrid, somewhat convex. Margin thin, at first brownish but becoming concolorous, at length excluded.

Hypothecium pallid or very pale brown (in thick sections); stipes colorless; exciple pallid but brown at margin. Hymenium ca. 85 μ thick, colorless, not inspersed with oil drops; paraphyses forming a brown epithecium. Apical cells of paraphyses enlarged and fusco-capitate. Spores 8 in ascus, brown, 1-septate, but frequently exhibiting shadowy secondary septation indicative of an incipient 3-septate condition, 10–12 $\times$ 5–6 μ.

Chemical Reactions: Epithecium KOH + (yellow), other apothecial tissues KOH − ; thallus section KOH + (yellow), I − .

A saxicolous species known only from Isle of Pines.

Material seen: CUBA (ISLE OF PINES) — on sandstone, La Cañada, *Britton, Britton & Wilson 14579*, Feb. 16, 1916 (FH-Riddle, NY); Las Tunas Mts., on quartz, Las Tunas, *Britton, Britton & Wilson 15518*, Feb. 22, 1916 (FH, FH-Riddle, NY).

Buellia calispora (Knight) Steiner, Bull. Herb. Boissier, ser. 2. 7: 645. 1907.

Lecidea callispora Knight, Trans. Linn. Soc. London, ser. 2, Bot. 2: 45. 1882.
Karschia fraudans Starb. Bih. K. Svensk. Vet.-Akad. Handl. 25 (III,1): 10. 1899.
Buellia didyma Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 91. 1915.
Buellia rinodinospora Riddle, Bull. Torrey Bot. Club. 44: 321. 1917.
Buellia blasteniospora Zahlbr. Ann. Mycol. 33: 45. 1935.

Type collections: *Lecidea callispora* — Collected on bark of trees in Sidney, New South Wales by Knight. I have not located the type specimen.

Karschia fraudans — I have not located the type specimen but Nannfeldt (1932, p. 323) cites Malme's study of the type specimen as reason for putting *K. fraudans* in synonymy with *B. callispora*.

Buellia didyma — Collected by P. Duss, no. 161, at Basse-Terre, Guadeloupe (West Indies). Holotype in TUR (Vainio Herb. no. 9530).

Buellia rinodinospora — Collected by J. A. Cushman, no. 155, March 19, 1912, at Newcastle (4000 ft. elevation), Jamaica (West Indies). Holotype in FH (Riddle Herb.); isotypes in FH and MICH.

Buellia blasteniospora — Collected by Rapp, no. 95, on oak at Sanford, Florida (U.S.A.). An isotype is in FH. I have not seen the holotype.

HYPOTHALLUS not seen except as a black line delimiting thallus. THALLUS glaucous-cinereous, soon continuous from coalescent granules or patches; surface frequently somewhat verrucose and, when thick, becoming rimose. APOTHECIA 0.4–1.2 mm. across, scattered, superficial. Disk black, dull, naked, plane to somewhat convex. Margin concolorous and moderately thick.

Hypothecium, stipes and exciple $\pm$ confluent, dark brown. Hymenium 100–200 μ thick, colorless, inspersed with oil drops; paraphyses forming a pale yellow-brown epithecium. Apical cells of paraphyses only slightly enlarged and fusco-capitate. Spores 8 in ascus (occ. 4 or 6), 1-septate, with walls thickened at septum (forming isthmus) and also just below the apex, sometimes slightly curved, 29–42 $\times$ 14–21 μ, germinating at both ends. Young spores more or less colorless, non-septate and with a slight halo. (See fig. 2G)

Chemical Reactions: Apothecial tissues KOH − ; thallus section KOH − .

A hygrophytic, corticolous and lignicolous species of wide distribution. In addition to the West Indian material collections have been examined from the United States, South America and the Hawaiian Islands.

Material seen: JAMAICA — Newcastle, 4000 ft., *Cushman 155*, March 19, 1912 (FH, FH-Riddle, MICH); Cinchona, 1500 m., *Maxon & Killip 1275*, March 20, 1920 (FH); Goshen, 1000 ft., *Imshaug 15984*, May 8, 1953 (Imsh); Coopers Hill, 2450 ft.,

Imshaug 14126, Jan. 27, 1953 (Imsh); Bellevue to Mt. Rosanna, 3800 ft., *Imshaug 14465 & 14482*, Feb. 4, 1953 (Imsh); Birchs Hill, 1809 ft., *Imshaug 15704*, April 24, 1953 (Imsh); Farm Hill, 4000 ft., *Imshaug 14785*, Feb. 21, 1953 (Imsh); ridge northwest of Murdocks Gap, 3600 ft., *Imshaug 15337*, March 15, 1953 (Imsh); Guava Ridge, 2900 ft., *Imshaug 14335a*, Feb. 3, 1953 (Imsh); forest hut above Corn Puss Gap, 3550 ft., *Imshaug 13455*, Nov. 20, 1952 (Imsh); forest hut at Murdocks Gap, 3300 ft., *Imshaug 15299a*, March 15, 1953 (Imsh).

GUADELOUPE — Basse-Terre, *Duss 510*, 1897 (NY); Basse-Terre, *Duss 161* (Tur-Vainio 9530).

Buellia catasema (Tuck.) Tuck. Syn. N. Am. Lich. 2: 161. 1888.

Lecidea catasema Tuck. Proc. Am. Acad. Arts & Sci. 6: 283. 1866.
Buellia hioramí B. de Lesd. Bull. Soc. Bot. France 87: 140. 1940.

Type collections: *Lecidea catasema* — Collected on tree in Cuba (West Indies) by Wright, no. 242. Holotype in FH (Tuckerman Herb. 3296).

Buellia hioramí — The original description is based on two collections made in Cuba by Frère Hioram in 1930. The two localities (El Palenque, alt. 400 m., and Loma San Juan, alt. 1000 m.) are both in Province de Oriente. A holotype was not designated and both collections were destroyed in World War II. No duplicates have been located.

HYPOTHALLUS seen only as a black delimiting line between a thallus of *B. catasema* and a thallus of another species. THALLUS composed of small (0.05–0.15 mm. across), cinereous or very pale sulphureous granules which are scattered over the bark or are ± coalescent to form a rather continuous but granulose crust. APOTHECIA 0.2–0.4 mm. across, scattered or occasionally conglomerate, narrowly constricted at base. Disk black, dull, naked, ± plane. Margin concolorous, rather thin and inconspicuous.

Hypothecium and stipes brown, confluent. Exciple thin, brown. Hymenium 40–65 μ thick, not inspersed with oil drops, usually colored with shades of green, yellow and brown; paraphyses forming a brown epithecium, with apical cells enlarged and fusco-capitate. Spores brown, 1-septate, smooth, walls thin and even, (9) 11–14 (15) × 4–6 (7) μ.

Chemical Reactions: Apothecial tissues KOH − (or, occasionally, hypothecium KOH +, red out in solution, but no crystals formed); thallus section KOH − (except for red areas in var. *sanguinariella*).

A mesophytic, corticolous species found also in the United States, Central America and South America.

var. **catasema**

Medulla white, KOH − .

Material seen: CUBA — *Wright 242* (FH-Tuckerman 3296); on *Conocarpus*, Isle of Pines, Siguanea, *Britton, Britton & Wilson 14940*, Feb. 26, 1916 (FH-Riddle, NY).

JAMAICA — Flora River, 2700 ft., *Imshaug 14379*, Feb. 3, 1953 (Imsh); gap southeast of Catherines Peak, 4500 ft., *Imshaug 13893*, Jan. 12, 1953 (Imsh).

GRENADA — Tree on cultivated slope of Mt. Maitland, 1050 ft., *Imshaug 16204*, July 15, 1953 (Imsh); on Coconut in cultivated area along Grand Etang Road near Good Hope Water Works, 950 ft., *Imshaug 16238*, July 19, 1953 (Imsh).

var. **sanguinariella** (Nyl.) comb. nov.

Lecidea parasema var. *endococcina* Tuck. Proc. Am. Acad. Arts & Sci. 4: 283. 1866.
Lecidea sanguinariella Nyl. Ann. Sci. Nat. V. 7: 328. 1867.
Buellia sanguinariella (Nyl.) Zahlbr. in Rechinger, Denkschr. Math.-Nat. Kl. Akad. Wiss. Wien 81: 275. 1907.
Buellia endococcodes Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 92, 1915.

Type collections: *Lecidea parasema* var. *endococcina* — Collected on bark in Cuba (West Indies) by Wright. Holotype in FH (Tuckerman Herb. 3296).

Lecidea sanguinariella — Collected on a tree at Rio Negro, alt. 1200 m., in New Granada by Lindig in 1863. Holotype in H (Nylander Herb. 10642).

Buellia endococcodes — Collected on *Byrsonima* near Sofaga in Guadeloupe (West Indies) by P. Duss no. 1413. Holotype in TUR (Vainio Herb. 9446).

Medulla frequently bright red. The red areas are KOH + (lavender color out in solution, no crystals).

Material seen: BAHAMAS — Crooked Island, *Brace* (MICH); Jingo Hill, Crooked Island, *Brace 4758*, Jan. 18, 1906 (FH-Riddle, NY); Vauxhall, Crooked Island, *Brace 4726*, Jan. 16, 1906 (FH-Riddle, NY).

CUBA — *Wright* (FH-Tuckerman 3296); on *Cocothrinax*, La Canada, Isle of Pines, *Britton, Britton & Wilson 14423a*, Feb. 16, 1916 (NY); on *Colpothrinax*, San Pedro, Isle of Pines, *Britton & Wilson 14827*, Feb. 12–March 22, 1916 (FH-Riddle, NY); Isle of Pines, *Britton & Wilson* (MICH).

JAMAICA — north slope of Montpelier, 2100 ft., *Imshaug 14271*, Jan. 29, 1953 (Imsh).

GUADELOUPE — Sofaga, *Duss 1413* (TUR-Vainio 9446).

GRENADA — Mt. Maitland, 1050 ft., *Imshaug 16201 & 16203*, July 15, 1953 (Imsh).

I have been unable to detect any difference between *B. catasema* and *B. sanguinariella* other than the red color of the medulla. This color appears quite variable, at times even in the same thallus. My collections from Mt. Maitland in Grenada were a mixture of the two varieties.

It seems reasonably certain from the original description that *B. hiorami* is this species.

Buellia dejungens (Nyl.) Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 79. 1915.

Lecidea dejungens Nyl. Ann. Sci. Nat. IV. 19: 355. 1863.

Buellia dejungens var. *chrysophaea* Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 80. 1915.

Buellia dejungens var. *chrysochlora* Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 81. 1915.

Buellia dejungens var. *chrysochroa* Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 82. 1915.

Buellia endochrysea Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 83. 1915.

Buellia finkii Merrill in Hedrick, Mycologia 22: 255. 1930.

Type collections: *Lecidea dejungens* — Collected by C. Wright "ad rupes calcareas" in Cuba (West Indies). Holotype in H (Nylander Herb. 5726b).

Buellia dejungens var. *chrysophaea* — Collected at Magensbay Estate in St. Thomas (West Indies) by F. Boergesen, Dec. 28, 1905. Holotype in C.

Buellia dejungens var. *chrysochlora* — Wainio cited two collections. The St. Jan collection is the only one in C but no spores could be found in it. The St. Croix collection in TUR (Vainio Herb. 9525) consists of one fragment and I have selected it as the lectotype.

Buellia dejungens var. *chrysochroa* — Collected at Rustenberg in St. John (West Indies) by F. Boergesen, March 15, 1906. Holotype in C.

Buellia endochrysea — Collected at 800 ft. elevation on Magensbay Estate in St. Thomas (West Indies) by F. Boergesen. Holotype in C; a fragment is in TUR (Vainio Herb. 9539), but it does not have well-developed *B. endochrysea* on it.

Buellia finkii — Collected at Aibonito (eastward exposure at 2100 ft.), Puerto Rico (West Indies) by Bruce Fink, no. 1884, Jan. 4, 1916. Holotype in MICH; isotypes in FH & NY.

HYPOTHALLUS usually evident only at periphery as a thin black border. When the thallus is exceptionally well-developed a black hypothallus may be seen occasionally

between the areoles. THALLUS usually very thin and continuous, becoming somewhat rimulose. Surface smooth and somewhat nitidous. Color variable, from cinereous to somewhat greenish or sordid yellowish or brownish; frequently blackening along the cracks. When well-developed the thallus becomes thick and areolate. Medulla usually white but occasionally yellow or orange in spots. APOTHECIA 0.2–0.7 mm. across, narrowly constricted at base. Disk usually black, but occasionally ± reddish brown, dull, naked, plane (rarely convex on well-developed specimens). Margin moderately thick (although excluded when disk becomes convex) and raised, concolorous.

Hypothecium pallid or yellowish; stipes orange or reddish-brown; exciple dark brown. Hymenium 60–85 (100–120) μ thick, colorless, not inspersed with oil drops; paraphyses forming a conspicuous dark brown epithecium. Apical cells of paraphyses enlarged and fusco-capitate. Spores 8 in ascus, pale fuscous, 1-septate with very thick walls (not mischoblastiomorph), 14–18 (21) × (6) 7–9 (11) μ. (See fig. 2C)

Chemical Reactions: Stipes, hypothecium and exciple KOH + (deep lavender purple out in solution), other apothecial tissues KOH – ; thallus section I – , Pd – , portions KOH + (deep lavender purple out in solution).

A mesophytic, saxicolous species known only from the West Indies.

Material seen: CUBA — locality unknown, *Wright* (H-Nylander 5726b).

PUERTO RICO — Rio Cuyan, *Britton 8565*, Feb. 13, 1926 (NY); Dos Bocas above Corozal, *Britton, Britton & Chardon 8948 & 8952*, Feb. 25, 1927 (MICH, NY); 2100 ft., Aibonito, *Fink 1884*, Jan. 4, 1916 (FH, MICH, NY); 2200 ft., Aibonito, *Fink 1940*, Jan. 5, 1916 (FH, MICH).

ST. THOMAS — Water Bay, *Britton, Britton & Kemp 14*, March 10–16, 1923 (MICH, NY); Tutu, *Britton, Britton & Kemp 26*, March 10–16, 1923 (MICH, NY); Tutu, *Britton, Britton & Marble 469b*, Feb. 8–9, 1913 (FH-Riddle, MICH, NY); Botany Bay, *Britton, Britton & Kemp 36*, March 10–16, 1923 (MICH, NY); Magensbay Estate, Boergesen, Dec. 28, 1905 (TUR-Vainio 9539 & C); Loevenlund, *Raunkiaer 404*, Dec. 15, 1905 (C).

ST. CROIX — Hams Bluff, *Boergesen*, Feb. 6, 1906 (C); summit of Mt. Eagles, *Boergesen*, Jan. 28, 1906 (C); Caledonia Dal, *Boergesen*, Feb. 16, 1906 (TUR-Vainio 9525).

ST. JOHN — Esperance, *Boergesen*, March 7, 1906 (C); Rustenburg, *Boergesen*, March 15, 1906 (C).

This species is rather common in Puerto Rico and the Virgin Islands and Wainio has described three varieties and one closely related species from this region. These appear to the present writer to be merely ecological variations and are not recognized nomenclaturally.

The original material collected in Cuba by Wright has a very thin, continuous thallus, quite green in color (due to the absence of a cortex) and is nitidous. It is only barely becoming somewhat rimulose. The green color is apparently from the algal layer.

Most material collected of this species has a thicker thallus with a sordid cinereous-fuscescent color and not so nitidous. The thallus is also noticeably rimose-areolate. The cracks in the thallus frequently blacken and the thallus has a variegated appearance. This brown, areolate variation was described by Wainio as var. *chrysophaea*.

Occasionally the disk of the apothecium appears rusty in color, rather than black. This is due to a development of the orange-yellow pigment, typical of the hypothecium, in the epithecium. This variation was described by Wainio as var. *chrysochroa*.

Buellia dejungens var. *chrysochlora* and var. *chrysochroa* were both characterized by Wainio as "thallus cinereo-glaucescens, nitidulus." The original material, however, is fragmentary and, in part, overgrown by other species. In some instances it is possible that there was confusion with an adjacent sterile thallus.

In the type collection of *B. finkii* the thallus is exceptionally well-developed with thick, cinereous areoles. The areoles are occasionally somewhat dispersed. A transition, however, can be observed from a thin, continuous, sordid yellow-brown thallus

on one face of the rock to a thick, areolate, cinereous thallus on another side of the rock. Isotype material of *Buellia finkii* was annotated by Wainio as *Buellia dejungens*.

The original collection of *B. endochrysea* is rather fragmentary and my impression is that it represents an interesting case of regeneration in *B. dejungens*. The thallus consists of an areolate form of *B. dejungens* which has blackened completely in several places. Small squamules appear on the surface of the blackened areoles. In another place a thin, branching, brown, laciniate thallus also is growing on the blackened areoles. There are no apothecia on the laciniate thallus. The apothecia on the squamulose thallus are typical of *B. dejungens*.

Buellia dispersula Müll. Arg. Bull. Soc.

Bot. Belg. 32: 144. 1893.

Type collection: The only specimen in the Müller-Arg. Herb. (G) was collected by Tonduz in 1893 at San Marcos, Costa Rica.

HYPOTHALLUS scant, consists of only a few scattered black specks. THALLUS consists of scattered, small (up to 0.2 mm. long), frequently elongated areoles which occasionally form branching linear rows. At times the areoles are abundant and then are more or less contiguous. Areoles are white to cinereous, or speckled dark gray. APOTHECIA large for size of areoles, 0.4–0.6 mm. across, scattered, superficial, narrowly constricted at base. Disk black, naked, dull, plane. Margin concolorous and rather thick.

Hypothecium and stipes confluent, brown; exciple thick, ± pallid but brown at margin. Hymenium 50–60 μ thick, colorless, not inspersed with oil drops; paraphyses forming a brown epithecium, apical cells enlarged and fusco-capitate. Spores 8 in ascus, brown, 1-septate, walls thin and even, (11) 13–17 (19) $\times$ 6–7 μ.

Chemical Reactions: Hypothecium and stipes KOH + (red, crystals); thallus section I – ; KOH + (red, crystals).

A saxicolous, Central American species known from the Caribbean only from one island off the coast of Nicaragua.

Material seen: ISLA DE PROVIDENCIA — outcrop of volcanic rock, *Proctor*, May 1–9, 1948 (PH).

The above description is taken from the Caribbean collection which differs from the type from Costa Rica only in the smaller spores and thinner hymenium. The holotype of *B. dispersula* has spores 18–21 (33) $\times$ 8–10 (17) μ, and hymenium 85–100 μ thick.

Buellia efflorescens Müll. Arg. Hedwigia

32: 129. 1893.

Buellia tuamotensis Herre, Bryologist 56: 281. 1953.

Type collections: *Buellia efflorescens* — Collected on trees near Singapore by Maingay, no. 158. Holotype in K (not seen).

Buellia tuamotensis — Collected on trees on Raroia Atoll, Tuamotu Archipelago, by M. S. Doty in 1952. Preserved in BISH and private herbarium of A. W. Herre (not seen).

HYPOTHALLUS not seen. THALLUS at first in scattered patches but later coalescent into a continuous, smooth, cinereous to pale yellow-green or pale sulphureous crust, occasionally rimulose with age. Soralia either widely scattered or, occasionally, abundant and ± confluent, pale yellow, 0.1–0.3 mm. across. APOTHECIA 0.2–0.6 mm. across, narrowly constricted at base. Disk black, naked, dull, plane to convex. Margin thin, concolorous.

Hypothecium and stipes light brown. Exciple dark brown-black. Hymenium 50–60 μ thick, colorless, not inspersed with oil drops; paraphyses forming a brown epithecium, apical cells much enlarged and prominently fusco-capitate. Spores 1-septate, smooth, walls thin and even, 10–14 $\times$ 5–7 μ. Immature spores with many small oil droplets.

Chemical Reactions: Apothecial tissues KOH — ; thallus section KOH — .

A xerophytic and mesophytic, corticolous species of wide distribution on tropical islands.

var. **efflorescens**

Spores 8 in ascus.

Material seen: JAMAICA — White River Bay, 30 ft., *Imshaug 15765*, May 4, 1953 (Imsh); summit of Catherines Peak, 5000 ft., *Imshaug 13319*, Nov. 11, 1952 (Imsh); north slope of Portland Ridge, 200 ft., *Imshaug 13269*, Oct. 24, 1952 (Imsh); Montego Bay, *Cushman 91*, Feb.–March 1912 (FH, MICH, NY, F–1142406); Silver Hill Gap, 3450 ft., *Imshaug 14090*, Jan. 21, 1953 (Imsh).

ST. THOMAS — Crown, *Raunkiaer 421*, Nov. 31, 1905 (C — no apothecia).

GUADELOUPE — on *Coccoloba uvifera*, Basse-Terre, *Duss 1502* (TUR-Vainio 9229).

GRENADA — sea level, Grenade Bay, *Imshaug 16302*, July 24, 1953 (Imsh); sea level, Coconut Grove, Grand Anse Beach, *Imshaug 16068, 16073 & 16074*, July 4, 1953 (Imsh); sea level, Coconut Grove, Levera Bay, *Imshaug 16156 & 16158*, July 12, 1953 (Imsh); sea level, south coast of Point Saline, *Imshaug 16128 & 16129*, July 9, 1953 (Imsh); dry scrub woodlands, 100 ft., Morne Rouge Cove, *Imshaug 16136*, July 9, 1953 (Imsh).

This variety is probably more common than its present known distribution would indicate. The soralia are easily overlooked and many tropical records of *B. punctata* or *B. myriocarpa* probably refer to this species. It is doubtful if *B. punctata* occurs in the tropics.

If soralia are abundant the apothecia are scarce; likewise, if the soralia are scarce, apothecia are abundant. Occasionally, the thallus may be very scant, in which case the soralia are more difficult to detect.

var. **diminutiva** (Wainio) comb. nov.

Buellia polyspora var. *diminutiva* Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 93. 1915.

Type collection: Collected on a tree at Cane Bay in St. Croix (West Indies) by Raunkiaer, no. 467, Jan. 4, 1906. Holotype in C; isotype in TUR (Vainio Herb. 9494).

Thallus scant and soralia not so abundant as in var. *efflorescens*. Apothecia minute, 0.1–0.2 mm. across. Spores ca. 32 in ascus, pale fuscous, 6–10 × ca. 3 μ.

Material seen: PUERTO RICO — shrubs on dry open hill, Yauco, *Fink 1428*, Dec. 28, 1915 (FH); shrubs on dry hill top, Yauco, *Fink 1455*, Dec. 30, 1915 (F–1271625, FH, MICH, NY, US).

ST. CROIX — Cane Bay, *Raunkiaer 467*, Jan. 4, 1906 (C, TUR-Vainio 9494).

Soralia, although definitely present in the holotype from St. Croix, are not definitely present in the material from Puerto Rico.

Buellia gerontoides (Stirton) comb. nov.

Lecidea gerontoides Stirton, Trans. Glasgow Soc. Field Naturalists 4: 165. 1876.
Catillaria gerontoides (Stirton) Zahlbr. Cat. lich. univ. 4: 17. 1926.

Icones: Botany of the Maya Area, Miscellaneous Papers VI. Lichens from the Yucatan Peninsula by Joyce Hedrick. Plate 4, fig. b (photograph sub *B. aeruginascens*). Carnegie Inst. Wash. Publ. 461. 1936.

Type collection: Collected by Rev. G. Brodie on a tree near Port of Spain, Trinidad (West Indies). Holotype in BM.

HYPOTHALLUS not seen. A black delimiting line is seen only when thallus is adjacent to a thallus of a different species. THALLUS composed of small patches which soon coalesce to form a continuous, yellow-green or bright sulphureous (rarely pale sulphureous) crust. Thick thalli become somewhat rimose. APOTHECIA 0.3–1.5 mm. across, constricted at base. Disk covered with an aeruginose, yellow-green pruina, plane to occasionally ± convex. Margin black, frequently wavy or crenulate, occasionally pruinose on inside (near disk); thick, raised and conspicuous.

Hypothecium and stipes brown, confluent. Exciple occasionally ± pallid but usually brown. Hymenium 60–85 μ thick, colorless, not inspersed with oil drops; paraphyses not forming a colored epithecium, apical cells only slightly enlarged and scarcely fusco-capitate. Spores 8 in ascus, 1-septate, brown, smooth, walls thin and even, frequently germinating at both ends, 12–17 (21) × 5–7 μ.

Chemical Reactions: Epithecium KOH — (or occasionally producing balls of colorless crystals as in thallus), hypothecium KOH + (red, crystals); thallus section KOH + (balls of colorless crystals).

A xerophytic-mesophytic, corticolous species known only from the West Indies and Central America.

Material seen: ISLAND UNKNOWN — on Coconut, *Breutel* (M).

BAHAMAS — on *Cocothrinax jucunda*, Great Exuma, Stocking Island, *Britton & Millspaugh 3065*, Feb. 22–28, 1905 (FH-Riddle); on *Mimusops parvifolia*, Ship Channel Cay, Exuma Chain, *Britton & Millspaugh 2765*, Feb. 17, 1905 (FH-Riddle); Fortune Island, *Hitchcock 3*, Nov. 27, 1890 (MO–32455).

CUBA — bark of Red Mangrove, Cayo Largo, Prov. of Havana, *Proctor*, April 4–9, 1948 (PH).

JAMAICA — north slope of Portland Ridge, 200 ft., *Imshaug 13254*, Oct. 24, 1952 (Imsh); SE slope of Hellshire Hummock, 300–400 ft., *Imshaug 13685*, Dec. 16, 1952 (Imsh); sea level, Long Bay, *Imshaug 15582*, April 21, 1953 (Imsh); Montego Bay, *Cushman 89*, Feb.–March 1912 (FH, FH-Riddle, MICH, NY); sea level between Runaway Bay and Dry Harbour, on Coconut, *Imshaug 15998, 15999 & 16001*, May 9, 1953 (Imsh); White River Bay, 30 ft., *Imshaug 15761*, May 4, 1953 (Imsh); Dunn's River, 150 ft., *Imshaug 15739 & 15751*, May 4, 1953 (Imsh); stump of Coconut, Galina Point, sea level, *Imshaug 13863*, Dec. 27, 1952 (Imsh); sea level, Rocky Point, *Imshaug 15399, 15402, 15404*, April 7, 1953 (Imsh).

ST. CROIX — *Breutel* (H-Nylander 10289, M).

ST. THOMAS — on Coconut, Charlotte Amelia, *Britton, Britton & Marble 489a*, Feb. 8–9, 1913 (FH-Riddle, MICH, NY).

PETER ISLAND — *Britton & Shafer 862a*, Feb. 13–17, 1913 (FH-Riddle, NY).

ANEGADA — west end of island, *Britton & Fishlock 989a*, Feb. 19–20, 1913 (FH-Riddle, NY).

SAINT BARTHÉLEMY — sur écorces de Mapores, Camaruche, *LeGallo 404*, Aug. 26, 1951 (MO–174107).

GRENADA — sea level in Coconut Grove, Levera Bay, *Imshaug 16156, 16159, 16160 & 16161*, July 12, 1953 (Imsh); Coconut Grove, 200 ft., La Sagesse Little River, *Imshaug 16289 & 16291*, July 22, 1953 (Imsh); cultivated slope of Mt. Maitland, 1050 ft., *Imshaug 16197*, July 15, 1953 (Imsh).

SAN ANDRÉS — bark of Mango & Coconut, *Proctor*, April 22–27, 1948 (PH).

SWAN ISLAND — Nelson, April 1912 (FH).

In numbers 16197, 16289 & 16291 (all from Grenada) the color of the thallus was a very pale sulphureous and the pruina on the apothecial disk was almost white. In all other respects they agreed well with the description given.

This species has generally been called *B. aeruginascens*. These two species are not, however, identical, nor is *B. aeruginascens* identical with *B. melanochlora*. The differences between these and other species with pruinose disks are summarized in Table II.

I am indebted to Dr. I. M. Lamb for calling my attention to this species which was erroneously transferred to *Catillaria* by Zahlbruckner.

Buellia glaucotheca (Fée) Malme, Ark. Bot.

21A (14): 20. 1927.

Lecidea glaucotheca Fée, Suppl. Essai Crypt. Écorces Exot. Offic. 109. 1837.
Buellia subdisciformis (Leight.) Wainio f. *caesiopruinosa* Tuck. in Wainio, Étude Lich. Brésil 1: 167. 1890.

Type collections: *Lecidea glaucotheca* — "Habitat in corticibus Cinchonae Condamineae, H. et B." (Humboldt & Bonpland). The collection probably came from Peru since that is where Humboldt & Bonpland list the host plant from. I have not located the type collection.

Buellia subdisciformis f. *caesiopruinosa* — Collected by Wright, no. 240, in Cuba (West Indies). Holotype in FH (Tuckerman Herb. 3298).

HYPOTHALLUS not seen except as a black delimiting line around thallus. THALLUS cinereous or slightly sulphureous, soon continuous from coalescent patches, moderately thick and becoming somewhat rimose; surface rather rough. APOTHECIA 0.4–0.8 mm. across, scattered, superficial. Disk black but usually covered with a white pruina, plane. Margin black, moderately thick and slightly raised.

Hypothecium and stipes confluent, brown. Exciple ± pallid. Hymenium 80–100 μ thick, colorless, not inspersed with oil drops; paraphyses not forming a colored epithecium but epithecium appears gray due to pruina. Paraphyses filiform, apices neither enlarged nor fusco-capitate. Spores 8 in ascus, brown, 1-septate, walls thin and even, surface smooth, 18–28 × 7–10 (12) μ.

Chemical Reactions: Hypothecium KOH + (red, crystals), other apothecial tissues KOH − ; thallus section KOH + (red, crystals).

A hygrophytic, corticolous and lignicolous species known from the West Indies and South America.

Material seen: CUBA — *Wright 240* (FH-Tuck. 3298).

JAMAICA — *Cummings 316*, Feb.–March 1905 (FH); ridge NW of Murdocks Gap, 3600 ft., Blue Mountains, *Imshaug 15313*, March 15, 1953 (Imsh); Farm Hill, 4000 ft., S slope of Blue Mts., *Imshaug 14772*, Feb. 21, 1953 (Imsh); forest hut at Murdocks Gap, 3300 ft., *Imshaug 15299a*, March 15, 1953 (Imsh); forest hut at Corn Puss Gap, 3550 ft., *Imshaug 13455*, Nov. 20, 1952 (Imsh); summit of Blue Mt. Peak, 7400 ft., *Imshaug 13015*, Oct. 8, 1952 (Imsh); Belle View, *Plitt J–145*, July 8, 1919 (BPI).

As with most species whose thallus gives a KOH + (red, crystals) reaction the medulla is occasionally (but rarely) reddish in color.

This species is not identical with *B. aeruginascens*. For the differences between these two and other species with pruinose disks see Table II.

Buellia glaziouana (Krmphbr.) Müll. Arg.

Flora 63. 19. 1880.

Lecidea glaziouana Krmphbr. Flora 59: 317. 1876.
Rinodina thomae Tuck. Syn. N. Am. Lich. 1: 209. 1882.
Rinodina contiguella Wainio, Étude Lich. Brésil 1: 164. 1890.
Lecidea cohibilis Nyl. Sertum Lich. Trop. Labuan et Singapore 42. 1891.
Buellia contiguella (Wainio) Malme, Bih. K. Svenska Vet.-Akad. Handl. 28(III, 1): 5. 1902.
Buellia moreliiensis B. de Lesd. Lich. Mex. 26. 1914.
Melanaspicilia contiguella (Wainio) Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 79. 1915.
Melanaspicilia contiguella var. *vegetior* Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 79. 1915.
Buellia cohibilis (Nyl.) Zahlbr. Cat. lich. univ. 7: 344. 1931.
Buellia contiguella var. *vegetior* (Wainio) Zahlbr. Cat. lich. univ. 7: 346. 1931.

Type collections: *Lecidea glaziouana* — Collected "ad saxa granitica" in Prov. Rio de Janeiro, Brazil, by D. A. Glaziou, no. 3506. Holotype and two isotypes in M.

Rinodina thomae — Collected by T. M. Peters on sandstone rocks at Moulton, Alabama (U. S. A.). Holotype in FH (Tuckerman Herb. 2125); isotype in MICH.

Rinodina contiguella — Collected "ad rupem quartziticam" near Rio de Janeiro, Brazil, by E. A. Wainio, no. 59. Holotype in TUR (Vainio Herb. 9078).

Lecidea cohibilis — Collected on sandstone at Lookout Mt., Tennessee (U. S. A.) by

W. W. Calkins. Holotype in H (Nylander Herb.). Portions of this collection are in F-30152, FH, MICH, MO-34678, NY, and US.

Buellia moreliiensis — The original material was collected by Frère Arsène Brouard in Morelia, Mexico, on volcanic rocks. No holotype was designated and most of the material was destroyed in World War II. I have seen one of the collections from the private herbarium of A. H. Magnusson. Additional material may be in the unmounted collections at US.

Melanaspicilia contiguella var. *vegetior* — Collected on rock at Magensbay Estate, St. Thomas (West Indies) by F. Boergesen, Dec. 28, 1906. Holotype in C; isotype in TUR (Vainio Herb. 9081).

HYPOTHALLUS absent except as a narrow black margin delimiting the thallus from neighboring thalli. THALLUS thin to moderately thick, pale creamy yellow, continuous, becoming rimose-areolate. APOTHECIA 0.2–0.7 mm. across, immersed to emergent, not constricted at base. Disk black, naked, dull, plane. Margin moderately thick and raised, at first concolorous with thallus but soon blackening.

Hypothecium and stipes confluent, brown; the stipes often very poorly developed. Exciple pallid but brown at margin. Hymenium 60–70 μ thick, colorless, not inspersed with oil drops; paraphyses forming a brown epithecium, apical cells enlarged and fusco-capitate. Spores 8 in ascus, brown, 1-septate with thin, uniform walls, (10) 11–15 (16) $\times$ (5)6–7(8) μ.

Chemical Reactions: Apothecial tissues KOH − ; thallus section KOH + (clear yellow out in solution), C − , K(C) − , Pd + (cinnabar), I + (blue, in spots).

A mesophytic, saxicolous species of wide distribution in South America, North America, Central America and the West Indies.

The type specimen of *B. glaziouana* showed a blue reaction with iodine in the medulla. This is contrary to the statements of Wainio and Malme.

This is a common and variable lichen in the warmer regions of the Western Hemisphere. There are three main lines of variation:

1) Apothecia remain more or less immersed due to the poor development of the stipes. This variation was described as *Rinodina contiguella* by Wainio.

2) Thallus whitens and apothecial initials are frequently abortive. It is possible that these are responses to some nutritional deficiency. This variation has been called *B. poliocheila* (also, *B. antillarum*). *B. glaziouana* f. *albinea* Räs., however, represents an entirely different species.

3) Thallus contains a depsidone giving the reaction KOH + (red, crystals). This variation has been called *B. recepta* and *B. sensitiva*.

The last two variations are quite distinctive and are regarded as varieties.

var. **glaziouana**

Thallus yellowish, KOH + (yellow out in solution). Apothecia either adnate on surface of thallus or immersed in thallus.

Material seen: JAMAICA — SW slope near summit of Mt. Rosanna, 4000 ft., *Imshaug 13985 & 14005*, Jan. 14, 1953 (Imsh); Bellevue, 3800 ft., *Imshaug 14454*, Feb. 4, 1953 (Imsh); Halberstadt to Bloxburgh, 2800 ft., *Imshaug 15038*, March 3, 1953 (Imsh); NE slope of Catherines Peak, 4500 ft., *Imshaug 13808*, Dec. 26, 1953 (Imsh).

PUERTO RICO — Publito del Rio, *Britton & Britton 9426a*, Jan. 6, 1930 (MICH, NY); Naranjito, 2000 ft., *Fink 219*, Nov. 27, 1915 (MICH).

ST. CROIX — Cotton Valley, *Britton, Britton & Kemp 170*, March 17–25, 1923 (MICH, NY).

var. **poliocheila** (Wainio) comb. nov.

Buellia poliocheila Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 85. 1915.
Buellia antillarum B. de Lesd. Bull. Muséum Hist. Nat. Paris II. 15: 470. 1943.

Type collections: *Buellia poliocheila* — Collected on rocks at Ma Folie, St. Thomas (West Indies) by Biese. Holotype in C; isotype in TUR (Vainio Herb. 9541).

Buellia antillarum — Collected on volcanic rock at sea level at Anse du Sud de Bouillante, Guadeloupe (West Indies). Holotype in PC.

Thallus white or cinereous. Apothecial initials frequently abort, leaving shallow, ochraceous pits. Hymenium 50–65 μ thick; spores 10–12 (14) $\times$ 5–7 μ.

Material seen: JAMAICA — NE slope of Catherines Peak, 4500 ft., *Imshaug 13808 & 13815*, Dec. 26, 1952 (Imsh).

PUERTO RICO — Publito del Rio, *Britton & Britton 9425*, Jan. 6, 1930 (MICH, NY).

ST. CROIX — Cotton Valley, *Britton, Britton & Kemp 59*, March 17–25, 1923 (MICH, NY).

ST. THOMAS — Magensbay Estate, *Boergesen*, Dec. 28, 1906 (C); Ma Folie, *Biese* (C).

ST. JOHN — Cruz-Bay, Strandklipper, *Boergesen*, March 11, 1906 (C).

GUADELOUPE — Anse du Sud de Bouillante (PC).

Buellia antillarum was described as differing from *B. poliocheila* by virtue of a white hypothecium. The hypothecium in the type material of both species is, however, brown.

var. **sensitiva** (Zahlbr.) comb. nov.

Buellia sensitiva Zahlbr. Mycologia 22: 78. 1930.
Lecidea recepta Krmphbr. Flora 59: 318. 1876.
Buellia recepta (Krmphbr.) Müll. Arg. Linnaea 43: 36. 1880.

Type collections: *Buellia sensitiva* — Collected on rocks in an open field at Naranjito, Puerto Rico (West Indies) by Bruce Fink, no. 102, Nov. 25, 1915. Holotype in MICH.

Lecidea recepta — Collected "ad saxa granitica" in Prov. Rio de Janeiro, Brazil, by D. A. Glaziou, no. 3295, in 1869. Holotype and one isotype are in M.

Thallus somewhat duller and darker than in var. *glaziouana*; KOH + (red, crystals). Hymenium 60–75 μ thick; spores 12–16 (18) $\times$ 6–7 μ.

Material seen: PUERTO RICO — open field, Naranjito, *Fink 102*, Nov. 25, 1915 (MICH); Naranjito, *Fink 274*, Nov. 27, 1915 (FH, MICH, NY).

ST. THOMAS — Magensbay Estate, *Boergesen*, Dec. 28, 1905 (C).

The reaction of the thallus in the original material collected by Glaziou in Brazil is quite variable.

Buellia jamaicensis sp. nov.

Hypothallus nigricans, ad ambitum solum visus. Thallus tenuis, continuus, demum saepe rimulosus, leviter verruculoso-inaequalis aut partim sat laevigatus, ochraceus, intus interdum aurantiacus, KOH sanguineo-rubens, solutione mox cristalla acicularia formante; hyphis J coerulescentibus. Apothecia 0.3–0.6 mm. lata, basi constricta, disco plano, opaco, nudo, nigro, margine fuscescens, vulgo parum prominente, crassitudine mediocri. Hypothecium et stipes fusconigricans; excipulum extus fusconigricans, intus pallidum. Hypothecium, stipes et excipulum KOH sanguineo-rubens, solutione mox cristalla acicularia formante. Hymenium 65–70 μ altum, haud oleoso-inspersum, superne fuligineum. Sporae 8:nae, verruculosae, fuscae, 1-septatae, paene 3-septatae, (13) 14–19 μ longae, 7–10 μ crassae. Specimen typicum in saxo, prope Clifton Mount, 1341 m., insula Jamaica, legit H. A. Imshaug, no. 13591, Dec. 3, 1952. Holotypus in FH conservatus.

HYPOTHALLUS seen only as a narrow, black, delimiting zone at periphery of thallus. THALLUS ochraceous, frequently blackening, rather thin, continuous, becoming rimose and occasionally somewhat verrucose. Medulla orange-red in spots. APOTHECIA 0.3–0.6 mm. across, constricted at base. Disk black, dull, naked, plane. Margin rather thick and raised, usually brownish but occasionally showing an orange-red tint.

Hypothecium and stipes confluent, brown; exciple pallid, but brown at margin, occasionally somewhat orange-red above. Hymenium 65–70 μ thick, colorless, not

inspersed with oil drops; paraphyses forming a brown epithecium, apical cells enlarged and fusco-capitate. Spores 8 in ascus, brown, somewhat verruculose, 1-septate but walls thickened so as to approach a 3-septate condition, (13) 14–19 × 7–10 μ.

Chemical Reactions: Hypothecium, stipes, and exciple KOH + (red, crystals); thallus section KOH + (red, crystals); medulla I + (blue).

A hygrophytic species found only on non-calcareous rock in Jamaica.

Material seen: JAMAICA — summit of Catherines Peak, 5000 ft., *Imshaug 13370*, Nov. 11, 1952 (Imsh); near Clifton Mount, 4400 ft., *Imshaug 13591*, Dec. 3, 1952 (Imsh); SW slope of Mossmans Peak, 5200 ft., *Imshaug 14935*, Feb. 23, 1953 (Imsh).

The spores are unique in that they give a vague appearance of being 3-septate. They are apparently 1-septate with an incipient secondary septation which appears as a vague shadow. A similar type of spore has been observed in a Mexican species, *B. jajalpae* B. de Lesd.

Buellia lauricassiae (Fée) Müll. Arg.

Rev. Mycol. 9: 85. 1887.

Lecidea lauricassiae Fée, Suppl. Essai Cryptog. Écorc. Officin. 101. 1837.
Mannia lauri Trevis. Rivista Period. Lavori Accad. Padova 5: 77. 1857. (*nomen novum*)

Type collection: "Habitat frequenter supra corticem Lauri Cassiae (cortex Cassiae ligneoe officinarium), et verosimilliter in Indiis supra cortice variarum arborum." I have been unable to locate the type collection.

HYPOTHALLUS seen only as black line at margin and at junction of thalli. THALLUS continuous, white to glaucescent, occasionally becoming somewhat verrucose; thickened thalli become somewhat rimose-areolate. APOTHECIA scattered, 0.3–1.0 mm. across, somewhat constricted at the base. Disk black, naked, dull, ± plane. Margin moderately thick and raised, concolorous.

Hypothecium and stipes confluent, brown; stipes extending into thallus. Exciple pallid but brown at margin. Hymenium 60–80 μ thick, colorless, not inspersed with oil drops; paraphyses forming a brown epithecium, apical cells enlarged and fusco-capitate. Spores 8 in ascus, brown, 3-septate, walls thin and even, 17–21 × 6–8 μ.

Chemical Reactions: Hypothecium and stipes KOH + (red, crystals); thallus section KOH + (red, crystals).

A mesophytic, corticolous species common in tropical and subtropical regions. Known in the Western Hemisphere from United States, West Indies, and South America, but not from Central America.

Material seen: CUBA — locality unknown, *Wright II 133* (US); *Wright 239* (FH, US); *Wright* (MICH).

JAMAICA — locality unknown, *Cummings 253*, Feb.–March 1905 (FH); Kalorama to Halberstadt, 2250 ft., *Imshaug 15004*, March 3, 1953 (Imsh); N slope of Montpelier, 2100 ft., *Imshaug 14256*, Jan. 29, 1953 (Imsh); sea level, Long Bay, *Imshaug 15592*, April 21, 1953 (Imsh); Guava Ridge, 2900 ft., *Imshaug 14338a*, Feb. 3, 1953 (Imsh); Prospect Estate, White River, 300 ft., *Imshaug 15770*, May 5, 1953 (Imsh).

PUERTO RICO — open places, on posts, Aibonito, *Fink 1875 & 1876*, Jan. 4 (MICH); on Inga, Rio Portugues, N. of Prince, *Britton & Britton 7429*, Feb. 12, 1923 (MICH, NY); on *Terminalia*, San German, *Britton 4007*, Feb. 9, 1915 (FH-Riddle, MICH, NY).

ST. CROIX — Spotless Bay, *Evans 534*, Sept. 1927 (FH, MO–70746); Jolly Hill, *Raunkiaer 436*, Jan. 22, 1906 (C); Fair Plane, on Manchinil & Hematoxylin, *Boergesen*, Feb. 4, 1906 (C); Krauses Lagoon, *Raunkiaer 542*, Feb. 4, 1906 (C).

DOMINICA — Botanical Garden, Roseau, *Evans 63*, Sept. 5, 1926 (FH, NY).

This species is not synonymous with *B. triphragmia*, *B. geophila*, or *B. triphragmioides*. *Buellia lauricassiae* can be distinguished from these species by its pallid exciple and the KOH + (red, crystals) reaction of the thallus.

Buellia leucomela sp. nov.

Hypothallus nigricans, ad ambitum solum visus. Thallus tenuis, continuus, demum saepe rimulosus, laevigatus, sulphureus aut ochraceus, KOH non reagens. Apothecia 0.3–0.4 mm. lata, adnata, disco plano, opaco, nudo, nigro, margine tenui, nigro. Hypothecium et excipulum fusconigricans, KOH non reagens. Stipes pallidum, KOH non reagens. Hymenium 65–70 μ altum, haud oleoso-inspersum, superne fuligineum. Sporae 8:nae, fuscae, 1-septatae, verruculosae, 14–16 μ longae, 7 μ crassae. Specimen typicum in cortice arboris, Portland Ridge, 61 m., legit H. A. Imshaug, no. 13269, Oct. 24, 1952. Holotypus in FH conservatus.

HYPOTHALLUS seen only as a black delimiting line. THALLUS continuous, becoming somewhat rimulose, smooth, ± sulphureous or ochraceous. APOTHECIA 0.3–0.4 mm. across, break through thallus with remnants of thallus persisting around margin, adnate. Disk black, naked, dull, plane. Margin thin and concolorous.

Hypothecium and exciple confluent, brown. Stipes pallid, forming a pale layer between exciple and hypothecium. Hymenium 65–70 μ thick, colorless, not inspersed with oil drops; paraphyses forming a brown epithecium, apical cells somewhat enlarged and fusco-capitate. Spores 8 in ascus, 1-septate, surface verruculose, 14–16 $\times$ ca. 7μ.

Chemical Reactions: Apothecial tissues and thallus section KOH − .

A xerophytic species growing on bark in association (in Jamaica) with *B. yaucoensis* and *B. efflorescens*. Material has also been seen from the Gulf Coast of SE United States.

Material seen: JAMAICA — N. slope of Portland Ridge, 200 ft., *Imshaug 13269* Oct. 24, 1952 (Imsh).

The spores are not as markedly verrucose as in *B. trachyspora* but their roughened surface can nevertheless be seen under high power without the use of an oil immersion objective. The latter is, however, helpful in doubtful cases.

Buellia melanochlora (Krmphbr.) Müll. Arg.

Flora 68: 510. 1885.

Lecidea melanochlora Krmphbr. Flora 59: 250. 1876.

Type collection: Collected by Glaziou in "provincia brasiliensi Rio Janeiro." Two collection numbers are cited in the original description, no. 6293 and 6326. I have examined both numbers in the Krempelhuber Herb. (M) and only no. 6293 has notes by Krempelhuber. Number 6293 is, therefore, selected as the lectotype.

HYPOTHALLUS black, present only at periphery of the thallus where it is soon covered by the coalescing granules. THALLUS composed of small granules which are soon confluent, forming a continuous, pale sulphureous crust which is rather rough and occasionally somewhat rimose. APOTHECIA 0.4–1.2 mm. across, scattered, constricted at base. Disk black but covered with a yellow-green pruina, plane. Margin thick, black, raised and prominent.

Hypothecium and stipes confluent, brown. Exciple frequently ± pallid. Hymenium 75–100 μ thick, colorless, inspersed with very tiny oil drops or granules; apices of paraphyses scarcely enlarged and scarcely fusco-capitate, not forming a colored epithecium. Spores 8 in ascus, brown, 1-septate, smooth, walls thin and even, (17)19–28(31) $\times$ (7)8–10(12) μ.

Chemical Reactions: Epithecium KOH + (layer of yellow granules), hypothecium KOH + (red out in solution but no crystals); thallus section KOH − .

A mesophytic, corticolous species known outside the West Indies from United States (Florida) and South America.

Material seen: CUBA — *Wright 241* (FH-Tuck.).

JAMAICA — *Hart 15* (FH-Tuck., NY); *Cummings 283*, Feb.–March 1905 (FH); Mandeville, *Wight* (MICH); Mandeville, *Wight 83*, Jan. 28, 1909 (FH-Riddle); Mandeville, *Wight 107*, Feb. 11, 1909 (FH-Riddle); Bamboo, 2000 ft., *Imshaug*

15973, May 7, 1953 (Imsh); Albion, 2400 ft., *Imshaug 15897*, May 7, 1953 (Imsh); Coopers Hill, 2450 ft., *Imshaug 14143, 14157 & 14160*, Jan. 27, 1953 (Imsh); between Bellevue and summit of Mt. Rosanna, 3800 ft., *Imshaug 14485*, Feb. 4, 1953 (Imsh); gap SE of Catherines Peak, 4500 ft., *Imshaug 13901*, Jan. 12, 1952 (Imsh).

PUERTO RICO — open hill top, Aibonito, *Fink 1903*, Jan. 5, 1916 (FH, MICH, NY).

This species is not identical with *B. aeruginascens*. For the differences between these two species and other species with pruinose disks, see Table II.

Buellia modesta (Krmphbr.) Müll. Arg.

Flora 64: 524. 1881. (non Darb. 1923)

Lecidea modesta Krmphbr. Vidensk. Meddel. Naturhist. Foren. Kjobenhavn 5(1873): 23. 1874. (non Hue 1915)

Buellia granularis Müll. Arg. Rev. Mycol. 10: 68. 1888.

Type collections: *Lecidea modesta* — Collected on trees in Serra d'Estrella, central Brazil. I have been unable to locate the type specimen. It is not in the Krempelhuber Herb. (M), nor is it in C.

Buellia granularis — Collected on trees at Guarapi in Paraguay by Balansa, no. 4195, in 1887. Holotype in G.

HYPOTHALLUS visible only as a black border and delimiting line between thalli. THALLUS a moderately thick, glaucous-cinereous, continuous crust. Surface usually rather smooth but occasionally appearing somewhat verrucose, ± areolate in age. APOTHECIA 0.3–1.5 mm. across. Disk black, naked, plane (rarely somewhat convex). Margin thick and concolorous.

Hypothecium and stipes brown, confluent. Exciple pallid. Oil drops are commonly found in the upper part of the hypothecium and occasionally in the hymenium. Hymenium (50)70–100 μ thick, colorless, not inspersed with oil drops; paraphyses forming a brown epithecium, apical cells enlarged and fusco-capitate. Spores 8 in ascus, 1-septate, brown, end walls frequently somewhat thickened, especially on young spores. Young spores occasionally have oil droplets inside. (10)12–17(19) $\times$ 5–8(9) μ. (See fig. 2B)

Chemical Reactions: Hypothecium KOH + (red, crystals); thallus section KOH + (red, crystals).

A xerophytic-mesophytic, corticolous species which is very common in the tropical part of South America, Central America and the West Indies.

Material seen: BAHAMAS — on *Acacia coriophylla*, Eleuthera Point, *Britton & Millspaugh 5638*, Feb. 24, 1907 (FH-Riddle, NY); on *Exostema caribaeum*, Eleuthera Point, *Britton & Millspaugh 5642*, Feb. 24, 1907 (FH-Riddle, NY); Fortune Island, *Hitchcock 3*, Nov. 27, 1890 (MO–32455); on *Torrubia longifolia*, Rose Island, *Britton & Millspaugh 2165*, Jan. 27–28, 1905 (FH-Riddle, NY); on *Coccothrinax jucunda*, Great Exuma, Stocking Island, *Britton & Millspaugh 3068*, Feb. 22–28, 1905 (FH-Riddle, NY); on *Pseudophoenix sargentii*, Little San Salvador, *Britton & Millspaugh 5672*, Feb. 25–26, 1907 (FH-Riddle, NY); on *Torrubia longifolia*, Long Island, Clarence Town, *Britton & Millspaugh 6341*, March 16–19, 1907 (FH-Riddle, NY); on *Inaba caribaea*, Watling's Island, Cockburn Town, *Britton & Millspaugh 6062*, March 12–13, 1907 (FH-Riddle, NY); New Providence, *Brace 9781*, Dec. 19, 1918 (FH-Riddle, NY).

CUBA — locality unknown, *Wright* (US); *Wright 450 & 448* (FH-Tuck. 3295); on *Poinciana regia*, Artemisa, *Ames*, Jan. 8, 1902 (FH); Prov. Las Villas olim Santa Clara, Cienfuegos, Soledad, Atkins Botanical Garden, *Welch 9196*, Aug. 12, 1948 (MO–169602); Palmas San Juan, *Hioram 5569*, April 7, 1922 (BPI); Confluente Estate, *Hioram 5758*, March 9, 1922 (BPI); Nogueras Hill, *Hioram 5744*, Oct. 6, 1921 (BPI); on *Lysiloma*, Isle of Pines, Vivijagua, *Britton, Britton & Wilson 15034*, Feb. 28–29, 1916 (FH-Riddle, NY); on *Oxandra*, Isle of Pines, Sierra de los Caballos, *Britton & Wilson 15145*, March 2, 1916 (FH-Riddle, NY).

JAMAICA — locality unknown, *Cummings 147*, Feb.–March 1905 (FH-Riddle,

NY); Kalorama to Halberstadt, 2250 ft., *Imshaug 14999 & 15004a*, March 3, 1953 (Imsh); Cane River Falls, 400 ft., on Coconut & Akee, *Imshaug 14517 & 14521*, Feb. 10, 1953 (Imsh); near summit of Coopers Hill in Red Hills, 2500 ft., *Imshaug 13749*, Dec. 17, 1952 (Imsh); SE slope of Hellshire Hummock, 300 to 400 ft., *Imshaug 13691*, Dec. 16, 1952 (Imsh); N slope of Montpelier, 2100 ft., *Imshaug 14252, 14269 & 14274*, Jan. 29, 1953 (Imsh); Hollymount, Mt. Diablo, 2750 ft., *Imshaug 14236*, Jan. 28, 1953 (Imsh); N slope of Portland Ridge, 200 ft., *Imshaug 13257, 13258 & 13269*, Oct. 24 1952 (Imsh); hill near Malvern Hill, Malvern, *Britton 472*, Sept. 5, 1907 (FH-Riddle, NY); Potsdam, Malvern, *Britton 481*, Sept. 9, 1907 (FH-Riddle); Birchs Hill, 1809 ft., *Imshaug 15683*, April 24, 1953 (Imsh); Montego Bay, *Cushman 103*, Feb.–March 1912 (FH); Clarks Town, 750 ft., *Imshaug 16046 & 16038*, May 10, 1953 (Imsh); Albion, 2400 ft., *Imshaug 15908*, May 7, 1953 (Imsh); Bamboo, 2000 ft., *Imshaug 15974*, May 7, 1953 (Imsh); Claremont, 1800 ft., *Imshaug 15886*, May 7, 1953 (Imsh); Hopewell, 1400 ft., *Imshaug 15817*, May 6, 1953 (Imsh); Dunns River, 150 ft., *Imshaug 15750*, May 4, 1953 (Imsh); sea level, on Coconut, between Runaway Bay & Dry Harbour, *Imshaug 15997*, May 9, 1953 (Imsh); stump of Coconut near mouth of Bog River, Port Antonio, *Wight*, Dec. 30, 1905 (FH); Port Antonio, *Wight 31*, Dec. 30, 1905 (FH-Riddle); NE Point, sea level, *Imshaug 15382, 15385, 15387, 15392, 15395*, March 31, 1953 (Imsh); Rocky Point, sea level, *Imshaug 15396 & 15407*, April 7, 1953 (Imsh).

HAITI — on small dead tree in arid thicket, Mt. La Mine, St. Michel de l'Atalaye, Dept. du Nord, 350 m., *Leonard 8015f*, Dec. 15, 1925 (FH).

PUERTO RICO — locality unknown, *Britton & Brown* (MICH); on *Pithecolobium unguiscati*, Coamo Springs, *Britton 8563*, Feb. 13, 1926 (MICH, NY); on *Pithecolobium unguiscati*, Montalva, Punta Penones, *Britton, Cowell & Brown 4844*, March 2–4, 1915 (FH-Riddle, NY); bark of shrubs on dry hill top, Yauco, *Fink 1488*, Dec. 29, 1915 (FH, MICH, NY, US); bark of shrubs on exposed hill, Yauco, *Fink 1463*, Dec. 29, 1915 (FH); on *Cephalocereus*, Guanica, Salinas de Guanica, *Britton, Cowell & Brown 4932*, March 5–8, 1915 (FH-Riddle, NY); on *Pithecolobium unguiscati*, Guanica, *Britton, Cowell & Brown 4957*, March 5–8, 1915 (FH-Riddle, NY); on *Eugenia*, Guanica, Salinas de Guanica, *Britton, Cowell & Brown 4936*, March 5–8, 1915 (FH-Riddle, MICH, NY); on *Pithecolobium*, Desecheo Island, *Britton, Cowell & Hess 1611*, Feb. 18–19, 1914 (MICH, NY); Rio de Maricao, *Britton 4055a*, Feb. 10, 1915 (FH-Riddle).

ST. THOMAS — Mt. Crown, *Raunkiaer 419*, Nov. 31, 1905 (C).

ST. CROIX — Krauses Lagoon, *Raunkiaer 542*, Feb. 4, 1906 (C); near Frederiksted, *Evans 12*, Aug. 25, 1926 (FH).

GUADELOUPE — on *Mangifera indica* in Ravine-Chaude, *Duss 1416* (TUR-Vainio 9346).

Spore size is apparently related to elevation in Jamaica. Collections from localities of less than 400 ft. measure (10)11–14(17) × 5–7(8) μ, while collections from 750–2400 ft. measure 14–19(20) × 7–8(9) μ. This does not conform to a xerophytic-mesophytic distinction.

Extra large spores were found in Cuba (Wright 450 & 448) and Puerto Rico (Britton 4055a). These measured 20–32 × 11–12(14) μ.

Buellia placodiomorpha Wainio, Étude Lich.

Brésil 1: 172. 1890.

Type collection: Collected by Wainio "ad corticem arboris prope Sepitiba in civ. Minarum, n. 473" in Brazil. Holotype in TUR (Vainio Herb.); isotype in FH.

HYPOTHALLUS absent. THALLUS scant, frequently apparently absent. When present indefinite or somewhat furfuraceous, cinereous to dark gray. APOTHECIA 0.2–0.4 mm. across, scattered, somewhat constricted at base. Disk black, naked, dull, plane to ± convex. Margin very thin, concolorous.

Hypothecium brown or reddish brown; stipes brown; exciple thin and brown.

Hymenium 50–75 μ thick, colorless, not inspersed with oil drops; paraphyses forming a brown epithecium, apical cells enlarged and fusco-capitate. Spores 8 in ascus, pale fuscous, walls unevenly thickened but not strictly polarilocular, 14–17 $\times$ 6–8 μ. (See fig. 2H)

Chemical Reactions: Apothecial tissues KOH – ; thallus section KOH – .

A mesophytic species known also from Bermuda and South America.

Material seen: GRENADA — sea level, Antoine Bay, *Imshaug 16297*, July 24, 1953 (Imsh); sea level, Grenade Bay, *Imshaug 16304*, July 24, 1953 (Imsh); sea level, Coconut Grove, Levera Bay, *Imshaug 16157 & 16166*, July 12, 1953 (Imsh).

The West Indian material agrees well with the isotype at FH. It is possible that this species is identical with *Rinodina insperata* (Nyl.) Malme. Although first described by Nylander as a *Lecanora*, Nylander later (Crombie 1877) called it a *Lecidea*. Malme (1902) and Riddle (1916), however, place it in *Rinodina*, although Riddle states (p. 159) "An examination of an apothecium from an original specimen in Lindig's Lich. Nov. Gran. No. 2616 shows beyond doubt that Zahlbruckner's disposition of the species is correct, in spite of the thalline exciple having disappeared." I have not seen the type collection of *Lecanora insperata* Nyl. and so am unable to reach a decision at the present time.

Buellia placodiomorphoides sp. nov.

Hypothallus incertus. Thallus cinereus, tenuis, verrucoso-inaequalis, verrucis dispersis, 0.06–0.12 mm. latis, KOH lutescens. Apothecia 0.3–0.5 mm. lata, basi constricta, disco nigro, nudo, opaco, plana, margine nigro, vulgo parum prominente, crassitudine mediocri. Hypothecium et stipes fusconigricans, KOH non reagens. Excipulum intus pallidum oleoso-inspersum, extus fusconigricans; KOH non reagens. Hymenium 65–100 μ altum, haud oleoso-inspersum, superne aurantiaco-rufescens. Sporae 8:nae, fumoso-fuscescentes, 1-septatae, membranis lateralibus sat inaequaliter incrassatis, membranis apicibus parum incrassatis, 21–28 μ longae, 9–10 μ crassae. Specimen typicum in cortice arboris, Catherines Peak, 1524 m., insula Jamaica, legit H. A. Imshaug, no. 13343, Nov. 11, 1952. Holotypus in FH conservatus.

HYPOTHALLUS not seen, except perhaps as a black line delimiting thallus from neighboring thalli of other species. THALLUS a thin cinereous film over bark with rather widely scattered verrucae 0.06–0.12 mm. across. APOTHECIA scattered, superficial, constricted at base, 0.3–0.5 mm. across. Disk black, naked, dull, plane. Margin concolorous, moderately thick and somewhat raised.

Hypothecium brown; stipes brown and well-developed; exciple pallid with many oil drops and brown at margin. Hymenium 65–100 μ thick, colorless, not inspersed with oil drops; paraphyses forming an orange-brown epithecium, apical cells enlarged and fusco-capitate. Spores 8 in ascus, pale fuscous, 1-septate, with walls unevenly thickened, but not strictly polarilocular, germ pore at each end, 21–28 $\times$ 9–10 μ. (See fig. 2F)

Chemical Reactions: Apothecial tissues KOH – ; thallus section KOH + (yellow).

A hygrophytic, corticolous species known only from the Blue Mountains of Jamaica.

Material seen: JAMAICA — summit of Catherines Peak, 5000 ft., *Imshaug 13343*, Nov. 11, 1952 (F.H.).

This species is similar to *Buellia callispora* except that the spores are smaller and not thickened at the septum. Also, in *B. placodiomorphoides*, the oil drops are confined to the exciple, which is pallid. The spores are similar to those in *B. placodiomorpha* except that they are much larger. *Buellia placodiomorpha* does not have a pallid exciple.

Buellia posthabita (Nyl.) Zahlbr.

Cat. lich. univ. 7: 390. 1931.

Lecidea posthabita Nyl. Lich. Nov. Zeland. 111. 1888.
Buellia parachroa Wainio, Étud. Lich. Brésil 1: 175. 1890.
Buellia parachroa var. *interrupta* Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 86. 1915.

Buellia pachydermatica Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 87. 1915.
Buellia naranjitana Zahlbr. Mycologia 22: 79. 1930.

Type collections: *Lecidea posthabita* — Collected on rock at Honda, New Granada, by Lindig in 1861. Holotype in H(Nylander Herb. 10546).

Buellia parachroa — Collected on granite near Rio de Janeiro, Brazil, by Wainio, no. 104, in 1885. Holotype in TUR (Vainio Herb. 9443).

Buellia parachroa var. *interrupta* — Collected at Magensbay (800 ft.) in St. Thomas (West Indies) by F. Boergesen. Holotype in C; isotype in TUR (Vainio Herb 9522).

Buellia pachydermatica — Collected at Ma Follie in St. Thomas (West Indies) by Biese. Holotype in C; isotype in TUR (Vainio Herb. 9532).

Buellia naranjitana — Collected on rock in open field at Naranjito in Puerto Rico (West Indies) by Bruce Fink, no. 236, Nov. 27, 1915. Holotype in MICH; isotype in NY.

HYPOTHALLUS not evident except as a black delimiting line. THALLUS in form of scattered patches which may coalesce to cover a large area. Each individual patch retains a black delimiting margin. Patches generally ochraceous but occasionally whitening or becoming cinereous; thin and continuous, but becoming rimose-areolate. APOTHECIA 0.2–0.4 mm. across, adnate, only slightly constricted at base. Disk black, naked, plane. Margin concolorous, moderately thickened and somewhat raised.

Hypothecium and stipes colorless or pallid. Exciple very dark brown, occasionally tinted somewhat green, confined to sides. Hymenium 75–100 μ thick, colorless, not inspersed with oil drops; paraphyses forming a light brown epithecium, apical cells somewhat enlarged and fusco-capitate. Spores 8 in ascus, pale fuscous (darkening with age), mischoblastiomorph, occasionally swollen at center, (14)17–24 $\times$ (8)9–12(13) μ. (See fig. 2E)

Chemical Reactions: Apothecial tissues KOH — ; thallus section I — , KOH — , Pd — .

A mesophytic species widely distributed on rock in tropical West Indies and South America.

Material seen: JAMAICA — gap SE of Catherines Peak, 4500 ft., *Imshaug 13899*, Jan. 12, 1953 (Imsh); SW slope of Catherines Peak, 4450 ft., *Imshaug 13920*, Jan. 12, 1953 (Imsh); NE slope of Catherines Peak, 4500 ft., *Imshaug 13817 & 13813*, Dec. 26, 1952 (Imsh); SW slope of Mossmans Peak, 5200 ft., *Imshaug 14927*, Feb. 23, 1953 (Imsh); Galloway Lodge Trail above Mavis Bank Road, 2950 ft., *Imshaug 14444*, Feb. 4, 1953 (Imsh); Bellevue, 3800 ft., *Imshaug 14458*, Feb. 4, 1953 (Imsh); Birchs Hill, 1809 ft., *Imshaug 15696 & 15720*, April 24, 1953 (Imsh).

PUERTO RICO — Mannato, *Britton & Britton 8769*, Feb. 4, 1927 (MICH, NY); on serpentine, Indiera Fria near Maricao, 430–800 m., *Britton, Cowell, & Brown 4559 & 4561*, Feb. 19–22, 1915 (MICH, NY); on shale, Punta Guaniquilla, *Britton, Cowell, & Brown 4591*, Feb. 24, 1915 (MICH, NY); on limestone, hills between Cabo Rojo & San German, 100–350 m., *Britton, Cowell, & Brown 4329*, Feb. 17, 1915 (MICH, NY); Yauco, *Fink 1678*, Jan. 1, 1916 (F–1271784, FH, MICH); Yauco, *Fink 1387*, Dec. 28, 1915 (FH, MICH); open field, Naranjito, *Fink 236*, Nov. 27, 1915 (FH, NY).

ST. THOMAS — Ma Folie, *Biese* (TUR-Vainio 9532, C); Magensbay, 800 ft., *Boergesen* (TUR-Vainio 9522, C); no locality (C); locality unknown, *Forel*, 1878 (H-Nylander 28667).

ST. CROIX — Cotton Valley, *Britton, Britton, & Kemp 175*, March 17–25, 1923 (NY); Canebay, *Boergesen*, Jan. 26, 1906 (C); Hams Bluff, *Boergesen*, Feb. 6, 1906 (C).

ST. JOHN — Reef Bay, *Boergesen*, March 7, 1906 (TUR-Vainio 9533).

GUADELOUPE — locality & collector unknown (PC).

GRENADA — Piton near Levera, 700–750 ft., *Imshaug 16307 & 16316*, July 24, 1953 (Imsh).

In the collection from Hams Bluff (St. Croix) the thallus is very scant and the

specimen appears athalline. Also, the epithecium is very dark. In all other respects, however, it agrees with *B. posthabita*.

This species may be recognized by the colorless hypothecium and mischoblastiomorph spores. The spores are very similar to those in *B. atrofuscata*, which species, however, has a brown hypothecium and is not saxicolous.

Buellia prospersa (Nyl.) Riddle, Brookl.

Bot. Gard. Memoirs 1: 114. 1918.

Lecidea prospersa Nyl. Flora 63: 127. 1880.
Buellia pachyphragma Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 93. 1915.
Buellia orcularia Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 94. 1915.
Buellia substigmatea Fink in Hedrick, Mycologia 22: 255. 1930. (non Müll. Arg. Proc. Roy. Soc. Edinburgh 11: 465. 1882).
Rinodina prospera (Nyl.) Zahlbr. Cat. Lich. Univ. 7:544. 1931.

Type collections: *Lecidea prospersa* — Collected on rock in St. Thomas (West Indies) by Dr. Forel in 1878. Holotype in H (Nylander Herb. 9312).

Buellia pachyphragma — Collected at Reef Bay in St. John (West Indies) by F. Boergesen, March 7, 1906. Holotype in C. A fragment from this collection in TUR (Vainio Herb. 9533) consists only of *B. posthabita*.

Buellia orcularia — Collected on littoral rocks at Cruz-Bay, St. John (West Indies) by F. Boergesen, March 11, 1906. Holotype in C; isotype in TUR (Vainio Herb. 9531).

Buellia substigmatea — Collected on rock on rocky hill, Christiansted, St. Croix (West Indies) by Britton, Brittón, and Kemp, no. 79, in 1923. Holotype in MICH; isotype in NY.

HYPOTHALLUS frequently not observed on herbarium specimens but occasionally seen as a continuous, cinereous to pale fuscous film, black at periphery. THALLUS develops on hypothallus as small patches which coalesce to form a thin, continuous crust. Crust generally ochraceous but occasionally whitening, surface somewhat uneven, perhaps exhibiting a granulose tendency, and becoming rimose-areolate. APOTHECIA 0.2–0.5 mm. across, superficial on thallus, constricted at base. Disk black, naked, plane (occasionally convex in older apothecia). Margin concolorous, moderately thick and raised but becoming somewhat excluded in older apothecia.

Hypothecium and stipes confluent, brown. Exciple a very distinct dark brown layer. Hymenium 50–65 μ thick, colorless, not inspersed with oil drops; paraphyses forming a conspicuous dark brown epithecium, apical cells swollen and prominently fusco-capitate. Spores 8 in ascus, fuscons, polarilocular, 10–14 $\times$ 5–7 μ.

Chemical Reactions: Apothecial tissues KOH — ; thallus section I — , Pd — , KOH — (or yellow).

A saxicolous species endemic to the Virgin Islands.

Material seen: ST. CROIX — on hill, Christiansted, *Britton, Britton, & Kemp 79*, March 17–25, 1923 (MICH, NY).

ST. THOMAS — *Forel*, 1878 (H–Nyl. 9312); Ma Folie, *Biese* (TUR-Vainio 9532, with type of *B. pachydermatica*); Nordsidebugt, on maritime rocks, *Boergesen*, Dec. 28, 1905 (C, TUR-Vainio 11951).

ST. JOHN — Cruz-Bay, *Boergesen*, March 11, 1906 (TUR-Vainio 9531, C); Reef Bay, *Boergesen*, March 3, 1906 (C).

Buellia proximata Magn. in Magn. & Zahlbr.

Ark. Bot. 32A(2): 52. 1945.

Type collection: Collected on bark by the Hawaiian Bog Survey in 1938 (no. 6023) at Kokee (ca. 1100 m.) on Kauai (Hawaiian Islands). Holotype in S (not seen).

HYPOTHALLUS seen only as a black delimiting line. THALLUS white to glaucescent, continuous, becoming somewhat verrucose APOTHECIA 0.3–0.8 mm. across, constricted at base. Disk black, plane, dull, naked. Margin moderately thick, somewhat raised, concolorous.

Hypothecium, stipes and exciple confluent, brown. Stipes extends to base of thallus. Hymenium 60–100 μ thick, colorless, not inspersed with oil drops; paraphyses forming a brown epithecium, apical cells enlarged and fusco-capitate. Spores 8 in ascus, brown, 3-septate, walls thin and even, (16)21–32 $\times$ (7)8–11 μ. Young spores $\pm$ colorless and 1-septate with end walls thickened.

Chemical Reactions: Apothecial tissues KOH — ; thallus section KOH — .

A mesophytic, corticolous species known only from Jamaica, outside of the Hawaiian Islands.

Material seen: JAMAICA — locality unknown, *Cummings 88 & 394*, Feb.-March 1905 (FH); Flora River, 2700 ft., *Imshaug 14411*, Feb. 3, 1953 (Imsh); Guava Ridge, 2900 ft., *Imshaug 14338b*, Feb. 3, 1953 (Imsh).

Buellia remensa (Stirton) comb. nov.

Lecidea remensa Stirton, Trans. Glasgow Soc. Field Naturalists 4: 166. 1876.
Catillaria remensa (Stirton) Zahlbr. Cat. lich. univ. 4: 23. 1926.

Type collection: Collected on bark near Pork of Spain, Trinidad (West Indies) by Rev. G. Brodie. Holotype and an isotype in BM.

HYPOTHALLUS not seen. THALLUS of many small, scattered patches (or flattened verrucae), soon coalescent into a cinereous-glaucescent, smooth or occasionally remaining $\pm$ granulose, continuous crust which becomes somewhat areolate. APOTHECIA 0.3–0.9 mm. across, scattered, somewhat constricted at base. Disk black but generally covered with a white pruina, plane to convex. Margin black, thin, becoming excluded.

Hypothecium, stipes and exciple confluent, dark brown. Hymenium 45–70 μ thick, colorless, not inspersed with oil drops; paraphyses forming a greenish epithecium, apical cells somewhat enlarged and fusco-capitate. Spores 8 in ascus, brown, 1-septate, with walls evenly thickened leaving 1 spherical sporoblast in each cell, 13–17 $\times$ 6–8 μ.

Chemical Reactions: Epithecium KOH + (violet), hypothecium KOH + (red, crystals); thallus section KOH + (red, crystals).

A mesophytic-gygrophytic, corticolous species known only from the Caribbean area.

Material seen: JAMAICA — forest hut above Corn Puss Gap, 3550 ft., *Imshaug 13455 & 13462*, Nov. 20, 1952 (Imsh).

PUERTO RICO — Yunque, 1000 ft., *Fink 742*, Sept. 12, 1915 (MICH).

GRENADA — sea level in Coconut Grove, Levera Bay, *Imshaug 16160 & 16161*, July 12, 1953 (Imsh); S shore of Point Saline, sea level, *Imshaug 16127, 16124 & 16128*, July 9, 1953 (Imsh); summit of Morne Rouge, 275 ft., *Imshaug 16191 & 16194*, July 15, 1953 (Imsh).

The pruina is often difficult to see or may even be lacking in material from the wettest localities. In doubtful cases the pruina is best seen when a drop of water is put on the apothecium. The green color of the epithecium is also frequently rather obscure and the KOH reaction of the hypothecium is not very strong.

It is possible that *B. isabellina* Malme is synonymous with this species. The spores in *B. isabellina*, however, measure 11–14 $\times$ 7–8 μ.

For an outline of the differences between *B. remensa* and the other species with pruinose apothecia see Table II.

I am indebted to Dr. I. M. Lamb for calling my attention to this species which was erroneously transferred to *Catillaria* by Zahlbruckner.

Buellia rufofuscescens Wainio, Étude Lich.

Brésil 1: 172. 1890

Type collection: Collected "ad lignum in Carassa (1400 metr. s. m.) in civ. Minarum, n. 1167 b" (Brazil). Holotype in TUR (Vainio Herb.); isotype in FH (only isotype seen).

HYPOTHALLUS not seen. THALLUS composed of scattered, flattened, cinereous

granules (not constricted at base) which often coalesce to form a ± continuous crust. APOTHECIA 0.2–0.6 mm. across, scattered, narrowly constricted at the base. Disk black but usually covered with a reddish or red-brown pruina, plane. Margin black, thin and raised.

Hypothecium, stipes and exciple confluent, dark brown. Hymenium 45–55 μ thick, a very pale diffuse green (more conspicuously green in KOH), not inspersed with oil drops; paraphyses forming a brown epithecium, apical cells only slightly enlarged and fusco-capitate. Spores 8 in ascus, brown, 1-septate, smooth, walls thin, 10–13 × 4–5 μ.

Chemical Reactions: Exciple KOH + (violet out in solution), rest of apothecial tissues KOH − ; thallus section KOH − .

A hygrophytic, corticolous species known only from Brazil and Jamaica.

Material seen: JAMAICA — ridge NW of Murdocks Gap in Blue Mountains, 3600 ft., *Imshaug 15319*, March 15, 1953 (Imsh).

Similar to *B. elisae* except for the KOH reaction of the exciple. *Buellia epimarta* Malme, from Brazil, has larger spores and different chemical reactions.

Buellia subdispersula Riddle, Mycologia 15: 87. 1923.

Type collection: Collected on sandstone at La Cunagua on Isle of Pines (off S coast of Cuba) in the West Indies by N. L. Britton, E. G. Britton, & Percy Wilson, no. 14577, Feb. 19, 1916. Holotype in FH (Riddle Herb.); isotypes in MICH & NY.

HYPOTHALLUS consists of a few scattered black specks. THALLUS consists of cinereous or yellow granules which are either scattered or aggregated into clusters, occasionally forming small granulose-continuous patches. APOTHECIA 0.2–0.7 mm. across, superficial, base somewhat constricted. Disk black, naked, dull, plane to slightly convex. Margin thin and concolorous, at length excluded.

Hypothecium, stipes and exciple confluent and dark brown. Hymenium 75–95 μ thick, colorless, inspersed with oil drops; paraphyses forming a brown epithecium, apical cells enlarged and fusco-capitate. Spores 8 in ascus, pale fuscous, mischoblastiomorph, (13)14–20 × 7–9 μ.

Chemical Reactions: Apothecial tissues KOH − ; thallus section KOH − (or, with balls of colorless crystals), I − .

A saxicolous species known only from the Isle of Pines.

Riddle described this species and *B. flavogranulosa* from two collections made the same day at the same locality. The differences between these two collections are slight and, considering the paucity of the material, they scarcely warrant the recognition of two separate species. The differences, however, do warrent recognition as varieties.

var. **subdispersula**

Thallus consists of scattered, cinereous granules, 0.06–0.23 mm. across. The granules frequently aggregate into masses and may form ± continuous granulose areas. Spores 15–20 × 7–9 μ.

Chemical Reactions: Thallus KOH — (no balls of colorless crystals).

Material seen: CUBA (ISLE OF PINES) — La Cunagua, *Britton, Britton & Wilson 14577*, Feb. 19, 1916 (FH-Riddle, MICH, NY).

var. **flavogranulosa** (Riddle) comb. nov.

Buellia flavogranulosa Riddle, Mycologia 15: 86. 1923.

Type collection: Collected on sandstone at La Cunagua on Isle of Pines (off S coast of Cuba) in the West Indies by N. L. Britton, E. G. Britton, & Percy Wilson, no. 14578, Feb. 19, 1916. Holotype in FH (Riddle Herb.); isotypes in MICH & NY.

Thallus consists of scattered clusters (up to 0.43 mm. across) of small (0.06–0.14 mm. across) yellow granules. Spores 13–17 × 7–9 μ.

Chemical Reactions: Thallus KOH + (balls of colorless crystals).

Material seen: CUBA (ISLE OF PINES) — La Cunagua, *Britton, Britton & Wilson 14578*, Feb. 19, 1916 (FH-Riddle, MICH, NY).

Buellia subsensitiva sp. nov.

Hypothallus bene evolutus, continuus, cinereus aut cinereonigricans. Thallus tenuis e areolis formatus, cinereis, dispersis aut subcontiguis, planis, laevigatis, opacis; KOH sanguineo-rubens, solutione mox cristalla acicularia formante; hyphis J coerulescentibus. Apothecia 0.3–0.6 mm. lata, basi constricta, disco nigro, nudo, opaco, plano, margine crassitudine mediocri, nigro, vulgo parum prominente. Hypothecium et stipes fusconigricans; excipulum extus fusco-fuligineum aut olivaceofuligineum, intus pallidum. Stipes et excipulum KOH sanguineorubens, mox cristalla acicularia formante. Hymenium 45–70 μ altum, haud oleoso-inspersum, superne viride. Sporae 8: nae, fuscae, 1–septatae, membrana aequaliter modice incrassata, 9–12(13) μ longae, 5–6 μ crassae. Specimen typicum in saxo, Mt. Rosanna, 1219 m., insula Jamaica, legit H. A. Imshaug, no. 14002, Jan. 14, 1953. Holotypus in FH conservatus.

HYPOTHALLUS visible between the areoles as a gray or dark cinereous layer over the substratum. THALLUS consisting of thin, scattered, cinereous areoles. Areoles occasionally contiguous, forming small patches of a rimose-areolate crust; ± plane, smooth, dull. APOTHECIA 0.3–0.6 mm. across, somewhat constricted at base. Disk black, naked, dull, plane. Margin rather thick, soon concolorous with disk, somewhat raised.

Hypothecium and stipes confluent, brown; stipes well developed, extending to substratum. Exciple pallid but brown (or with tint of green) at margin. Hymenium 45–70 μ thick, colorless, not inspersed with oil drops; paraphyses forming a dark green epithecium (HCl − , KOH −), apical cells somewhat enlarged and fusco-capitate. Spores 8 in ascus, brown, 1-septate, with thin and uniform walls, 9–12(13) × 5–6 μ.

Chemical Reactions: Stipes and exciple frequently KOH + (red, crystals), rest of apothecial tissues KOH − ; thallus section KOH + (red, crystals), I + (blue at base).

A mesophytic species found only on non-calcareous rocks in Jamaica.

Material seen: JAMAICA — Halberstadt to Bloxburgh, 2800 ft., *Imshaug 15026, 15039 & 15046*, March 3, 1953 (Imsh); SW slope near summit of Mt. Rosanna, 4000 ft., *Imshaug 13985 & 14002*, Jan. 14, 1953 (Imsh).

Buellia subsensitiva differs from *B. sensitiva* Zahlbr. in that the thallus consists of scattered areoles on a well-developed hypothallus. Also, the stipes is a darker brown and is better developed; the epithecium is green and the spores are smaller. *Buellia subsensitiva* is not closely related to *B. glaziouana*.

Buellia trachyspora Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 84. 1915.

Buellia gyrosa Wainio, Ann. Acad. Sci. Fenn. ser. A. 6(7): 85. 1915.

Type collections: *Buellia trachyspora* — Collected by Boergesen "in rupem ad cataractam prope Reef-Bay in insula S. Jan" (West Indies). Holotype in C.

Buellia gyrosa — Collected on rock in St. John (West Indies) by Boergesen on March 15, 1906. Holotype in C; isotype in TUR (Vainio Herb. 9538).

HYPOTHALLUS not evident. THALLUS thin, continuous but becoming somewhat rimose-areolate, glaucous albescent to pale cream; surface smooth and even but not nitidous. APOTHECIA 0.4–1.0 mm. across, constricted at base. Disk black, naked, plane, dull. Margin rather thick and frequently raised above the disk, concolorous.

Hypothecium and stipes confluent, brown. Exciple pallid but brown at margin. Hymenium 75–100 μ thick, colorless, not inspersed with oil drops; paraphyses forming a brown epithecium, apical cells enlarged and fusco-capitate. Spores 8 in ascus, brown, 1–septate, strongly verrucose, 15–20(23) × 7–9(10) μ.

Chemical Reactions: Apothecial tissues KOH − ; thallus section KOH − , I − .

A mesophytic, saxicolous species known only from the Greater Antilles.

Material seen: CUBA — locality unknown, *Wright* (H-Nylander 5726, with type of *B. dejungens*).

JAMAICA — between Halberstadt and Bloxburgh, 2800 ft., *Imshaug 15047*, March 3, 1953 (Imsh).

PUERTO RICO — open field at 2000 ft., Aibonito, *Fink 1947*, Jan. 5, 1916 (BPI, FH, MICH, NY, US); exposed places at 2100 ft., Aibonito, *Fink 1846*, Jan. 4, 1916 (FH, MICH).

ST. THOMAS — *Boergesen*, March 7, 1906 (TUR-Vainio 9521).

ST. JOHN — Rustenburg, *Boergesen*, March 15, 1906 (TUR-Vainio 9538, C); Reef Bay, *Boergesen*, March 7, 1906 (C).

The original material of *B. gyrosa* is rather fragmentary and differs from *B. trachyspora* only in the gyrose nature of the apothecia. This condition occurs in almost all species with a thick, pallid exciple and scarcely warrants species recognition.

Buellia yaucoensis Vainio, Mycologia

21: 33. 1929.

Type collection: Collected on old log on open hill top at Yauco in Puerto Rico (West Indies) by Bruce Fink, no. 1460, Dec. 29, 1915. Holotype in MICH; isotypes in F (1270211), FH and NY.

HYPOTHALLUS not seen. THALLUS thin and continuous, cinereous glaucescent, smooth but becoming roughened or somewhat verrucose. APOTHECIA 0.3–0.6 mm. across, scattered, constricted at base, occasionally emergent with adherent thallus fragments. Disk black, naked, dull, plane to somewhat convex. Margin thin and concolorous.

Hypothecium and stipes confluent, light brown; exciple thin and dark brown. Hymenium 70–90 μ thick, colorless, not inspersed with oil drops; paraphyses forming a brown epithecium, apical cells of paraphyses enlarged and fuscocapitate. Spores 8 in ascus, brown, 1-septate, surface smooth, secondary walls evenly thickened so as to leave one small, spherical sporoblast in each cell, (13)14–18 $\times$ 6–9 μ. (See fig. 2D)

Chemical Reactions: Apothecial tissues KOH $-$, except exciple is frequently KOH $+$ (red-violet out in solution); thallus KOH $-$.

A xerophytic, corticolous species known only from the Greater Antilles.

Material seen: JAMAICA — N slope of Portland Ridge, 200 ft., *Imshaug 13269a*, Oct. 24, 1952 (Imsh); SE slope of Hellshire Hummock, 300 to 400 ft., *Imshaug 13710, 13703, 13702 & 13706*, Dec. 16, 1952 (Imsh).

PUERTO RICO — old log on open hill top, Yauco, *Fink 1460*, Dec. 29, 1915 (F–1270211, FH, MICH, NY).

SPECIES OF BUELLIA REPORTED IN THE LITERATURE FROM THE WEST INDIES

An asterisk (*) preceding a name indicates that the taxon was originally described from material collected in the West Indies. In those cases where I have examined the collection, or collections, upon which the reference is based I have indicated my revision in parentheses immediately following the reference citation.

Buellia sp.

JAMAICA: Johnson 1927 (The specimen is presumably in the undetermined collections at BPI and was not available for revision.)

Buellia aeruginascens (Nyl.) Zahlbr.

BAHAMAS: Riddle 1920, sub *B. parasema* var. *aeruginascens* (Nyl.) Müll. Arg. (= *B. gerontoides*)

BAHAMAS (Fortune Island): Hitchcock 1898 (= *B. gerontoides*)

ST. THOMAS: Riddle 1918, sub *B. parasema* var. *aeruginascens* (= *B. gerontoides*)

**Buellia antillarum* B. de Lesd.

GUADELOUPE: Type collection (= *B. glaziouana* var. *poliocheila*)

TABLE I — Distribution of the West Indian species of *Buellia*.

	United States	Bahamas	Cuba	Jamaica	Hispaniola	Puerto Rico	Virgin Islands	Guadeloupe	Dominica	Martinique	St. Vincent	Grenada	Trinidad	Islands off Central America	Central America	South America	Endemic to West Indies
B. atrofuscata				x												x	
B. bahiana	x	x	x	x		x	x			x					x	x	
B. boergesenii							x										x
B. brittoniae			x														x
B. callispora	x			x				x								x	
B. catasema	x	x	x	x				x				x			x	x	
B. dejungens			x			x	x										x
B. dispersula														x	x		
B. efflorescens				x		x	x	x				x					
B. gerontoides		x	x	x			x	x				x	x	x	x		
B. glaucotheca			x	x												x	
B. glaziouana	x			x		x	x	x							x	x	
B. jamaicensis				x													x
B. lauricassiae	x		x	x		x	x		x							x	
B. leucomela	x			x													
B. melanochlora	x		x	x		x										x	
B. modesta	x	x	x	x	x	x	x	x							x	x	
B. placodiomorpha	x											x				x	
B. placodiomorphoides				x													x
B. posthabita				x		x	x	x	?		?	x				x	
B. prospersa							x										x
B. proximata				x													
B. remensa				x		x						x	x				
B. rufofuscescens				x												x	
B. subdispersula			x														x
B. subsensitiva				x													x
B. trachyspora			x	x		x	x										x
B. yaucoensis				x		x											x

TABLE II — West Indian species of *Buellia* with pruinose apothecia. *Buellia aeruginascens* is included for comparison.

	spores	epithecium hymenium	hypothecium exciple	thallus	pruina
B. aeruginascens TYPE Nylander Herb. No. 10292	17–24 / ——— μ / (7)8–10 isthmus in young spores	epi. KOH — hym. without oil; 85–110 μ	hypo. KOH — exc. dark brown	continuous with surface ± granular; dull stramineous; KOH —	whitish or very pale yellow-green
B. gerontoides	12–17(21) / ——— μ / 5–7(9) walls thin	epi. KOH — or occ. balls of colorless crystals hym. without oil; 60–85 μ thick	hypo. KOH + red, crystals or occ. KOH — exc. ± dark, or occ. ± pallid	sulphureous or yellow-green; KOH + balls of colorless crystals; separate granules do not develop at margin over a black hypothallus.	yellow-green
B. glaucotheca	18–28 / ——— μ / 7–9(12) walls thin	epi. ± colorless; KOH — hym. without oil; 80–100 μ thick	hypo. KOH + red, crystals exc. ± pallid	Cinereous to very slightly pale sulphureous; continuous from coalescent patches, becoming rimose; KOH + red, crystals.	white, freq. very slight
B. melanochlora	(17)19–28(32) / ——— μ / (7)8–12(14) walls thin	epi. KOH + layer of yellow granules hym. with minute oil drops; 80–110 μ thick	hypo. KOH + red out in solution but usually no crystals exc. ± pallid	separate granules develop over the black hypothallus at margin; soon continuous; KOH —	yellow-green
B. remensa	13–17 / ——— μ / 6–8 walls evenly thickened	epi. greenish, KOH + violet hym. without oil; 45–70 μ thick	hypo. KOH + red, crystals (freq. weak) exc. dark brown	cinereous-glaucescent scattered patches soon continuous, becoming rimose; KOH + red, crystals	white, freq. very slight

**Buellia brittoniae* Riddle
CUBA (Isle of Pines): Type collection (= *B. brittoniae*)
**Buellia catasema* Tuck.
CUBA: Type collection (= *B. catasema*)
Welch 1950 (= *B. modesta*)
Buellia conspirans (Nyl.) Wainio
BAHAMAS: Riddle 1920 (= *B. modesta*)
ST. JOHN: Wainio 1915 (= *B. boergesenii*)
**Buellia contiguella* var. *vegetior* (Wainio) Zahlbr.
ST. THOMAS: Type collection, sub *Melanaspicilia contiguella* var. *vegetior* (= *B. glaziouana* var. *poliocheila*)
**Buellia dejungens* Nyl.
CUBA: Type collection (= *B. dejungens*)
**Buellia dejungens* var. *chrysochlora* Wainio
ST. CROIX: Wainio 1915 (= *B. dejungens*)
ST. JOHN: Wainio 1915 (= *B. dejungens*)
**Buellia dejungens* var. *chrysochroa* Wainio
ST. CROIX: Wainio 1915 (= *B. dejungens*)
ST. JOHN: Wainio 1915 (= *B. dejungens*)
ST. THOMAS: Wainio 1915 (= *B. dejungens*)
**Buellia dejungens* var. *chrysophaea* Wainio
ST. CROIX: Wainio 1915 (= *B. dejungens*)
ST. THOMAS: Wainio 1915 (= *B. dejungens*)
**Buellia didyma* Wainio
GUADELOUPE: Type collection (= *B. callispora*)
Buellia disciformis var. *insignis* (Naeg.) Wainio
GUADELOUPE: Wainio 1915 (= *B. callispora*)
Lecidea discolor Hepp
ST. THOMAS: Nylander 1880 (= *B. posthabita*)
Riddle 1918 (= *B. dejungens*)
**Buellia endochrysea* Wainio
ST. THOMAS: Type collection (= *B. dejungens*)
**Buellia endococcodes* Wainio
GUADELOUPE: Type collection (= *B. catasema* var. *sanguinariella*)
**Buellia finkii* Merrill in Hedrick
PUERTO RICO: Type collection (= *B. dejungens*)
**Buellia flavogranulosa* Riddle
CUBA (Isle of Pines): Type collection (= *B. subdispersula* var. *flavogranulosa*)
**Lecidea gerontoides* Stirton
TRINIDAD: Type collection (= *B. gerontoides*)
Buellia glaucotheca (Fée) Malme
CUBA: Malme 1927 (= *B. glaucotheca*)
**Buellia gyrosa* Wainio
ST. JOHN: Type collection (= *B. trachyspora*)
**Buellia hiorami* B. de Lesdain
CUBA: Type collection destroyed in World War II, but is presumed to be *B. catasema*.
Buellia lauricassiae (Fée) Müll. Arg.
CUBA: Malme 1927 (= *B. lauricassiae*)
ST. CROIX: Wainio 1915 (= *B. lauricassiae*)
ST. THOMAS: Wainio 1915 (= *B. bahiana*)
Buellia modesta (Krmph.) Müll. Arg.
CUBA: Malme 1927
ST. THOMAS: Wainio 1915 (= *B. modesta*)
ST. CROIX: Wainio 1915 (= *B. modesta* and *B. lauricassiae*)
GUADELOUPE: Wainio 1915 (= *B. modesta*)

Buellia myriocarpa (DC.) Mudd
DOMINICA: Wainio 1896 (Specimen not in Herb. Vainio)
ST. VINCENT: Wainio 1896 (Specimen not in Herb. Vainio)
**Buellia naranjitana* Zahlbr.
PUERTO RICO: Type collection (= *B. posthabita*)
**Buellia orcularia* Wainio
ST. THOMAS: Wainio 1915 (= *B. prospersa*)
ST. JOHN: Wainio 1915 (= *B. prospersa*)
**Buellia pachydermatica* Wainio
ST. THOMAS: Type collection (= *B. posthabita*)
**Buellia pachyphragma* Wainio
ST. JOHN: Type collection (= *B. prospersa*)
Buellia parachroa Wainio
DOMINICA: Wainio 1896 (Specimen not in Herb. Vainio)
ST. VINCENT: Wainio 1896 (Specimen not in Herb. Vainio)
**Buellia parachroa* var. *interrupta* Wainio
ST. THOMAS: Type collection (= *B. posthabita*)
Buellia parasema (Ach.) Th. Fr.
BAHAMAS (Fortune Island): Hitchcock 1898 (= *B. modesta*)
CUBA (Isle of Pines): Riddle 1923 (= *B. catasema*)
**Buellia parasema* f. *endococcina* Tuck.
CUBA: Type collection (= *B. catasema* var. *sanguinariella*)
**Buellia poliocheila* Wainio
ST. THOMAS: Wainio 1915 (= *B. glaziouana* var. *poliocheila* and var. *sensitiva*)
ST. JOHN: Wainio 1915 (= *B. glaziouana* var. *poliocheila*)
**Buellia polyspora* var. *diminutiva* Wainio
ST. CROIX: Type collection (= *B. efflorescens* var. *diminutiva*)
**Buellia prospersa* (Nyl.) Riddle
ST. THOMAS: Type collection (= *B. prospersa*)
Buellia punctiformis f. *punctata* (Koerb.) Wainio
GUADELOUPE: Wainio 1915 (= *B. efflorescens*)
**Lecidea remensa* Stirton
TRINIDAD: Type collection (= *B. remensa*)
**Buellia rinodinospora* Riddle
JAMAICA: Type collection (= *B. callispora*)
Buellia sanguinariella (Nyl.) Wainio
BAHAMAS: Riddle 1920 & 1923 (= *B. catasema* var. *sanguinariella*)
CUBA: Riddle 1920 & 1923 (= *B. catasema* var. *sanguinariella*)
CUBA (Isle of Pines): Riddle 1923 (= *B. catasema* var. *sanguinariella*)
**Buellia sensitiva* Zahlbr.
PUERTO RICO: Type collection (= *B. glaziouana* var. *sensitiva*)
PROVIDENCIA: Dix 1953 (= *B. dispersula*)
**Buellia stipitata* Riddle
JAMAICA: Type collection (= *Karschia stygia*)
Buellia subdisciformis (Leight.) Wainio
CUBA (Isle of Pines): Riddle 1923 (= *B. bahiana* and *B. modesta* and *B. catasema* var. *sanguinariella*)
JAMAICA: Riddle 1912 (= *B. modesta*)
**Buellia subdisciformis* f. *caesiopruinosa* Tuck. in Wainio
CUBA: Type collection (= *B. glaucotheca*)
**Buellia subdispersula* Riddle
CUBA (Isle of Pines): Type collection (= *B. subdispersula*)
**Buellia substigmatea* Fink in Hedrick (non Müll. Arg.)
ST. CROIX: Type collection (= *B. prospersa*)
**Buellia trachyspora* Wainio
CUBA: Malme 1927

ST. JOHN: Type collection (= *B. trachyspora*)
Buellia versicolor Müll. Arg.
SAN ANDRÉS: Dix 1953 (= *B. gerontoides*)
**Buellia yaucoensis* Wainio
PUERTO RICO: Type collection (= *B. yaucoensis*)

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Fig. 1. Map of the West Indies.

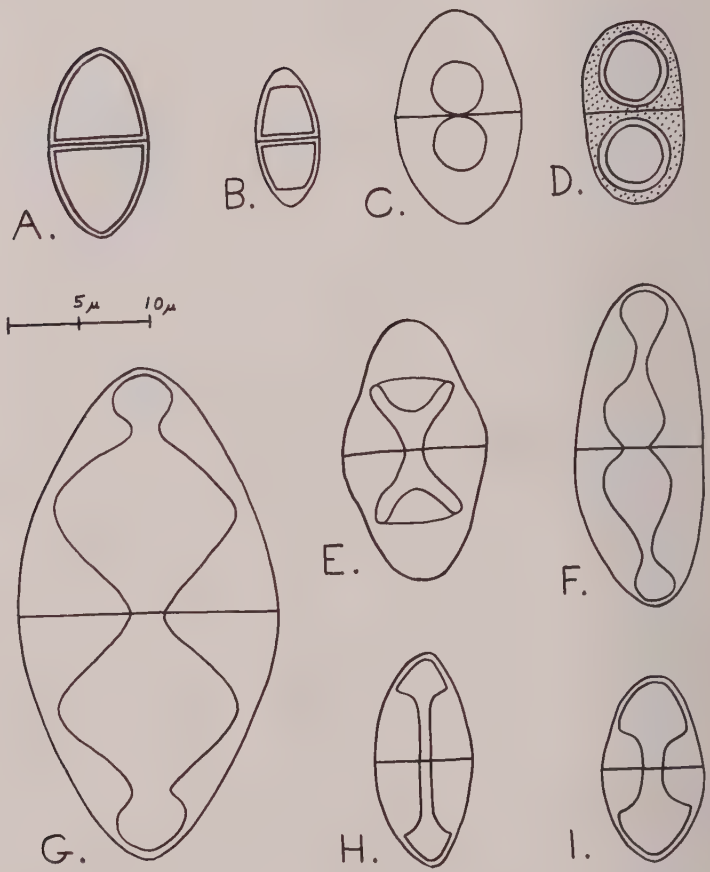

Fig. 2. Spore wall thickenings in *Buellia*. **A** — Spore walls and septum thin & uniform, common type; **B** — *B. modesta* (young spore); **C** — *B. dejungens*; **D** — *B. yaucoensis*, holotype; **E** — mischoblastiomorph, *B. posthabita*; **F** — *B. placodiomorphoides*, holotype; **G** — *B. callispora*; **H** — polarilocular, *B. placodiomorpha*; **I** — *B. boergesenii*, holotype.

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FRESHWATER ALGAE OF ALASKA

I. SOME DESMIDS FROM THE INTERIOR[1]

Hannah Croasdale

GEOGRAPHY AND GEOLOGY

Alaska forms the northwestern part of North America as a peninsula with an area of about 586,400 square miles. Most of it lies between latitude 60° and 71° N. and longitude 141° and 165° W. About one third of it lies north of the Arctic Circle, but only about one tenth of it, the "Arctic Slope," which slants from the Brooks Range north to the Arctic Ocean, is normally classified botanically as "arctic."

Alaska is of particular interest for scientific study because in spite of its high latitude it suffered less glaciation in the last great ice age than other northern parts of North America. Its glaciation is described by Brooks (1953) as "local rather than continental." This seems to have been due to the scanty precipitation during the coldest period. A broad belt extending from east to west across the middle of Alaska was believed to be practically unglaciated during the Pleistocene (Capps, 1931) while the mountainous regions, including Brooks Range to the north and the higher Alaskan and Coastal Ranges to the south, were deeply ice-covered. The largest glaciers in Alaska today are in the southern part of these highest mountains. Since algae and mosess could presumably survive a period of glaciation, if not themselves covered for too long or scoured away, it seemed interesting to see if relict forms could be found in these unglaciated areas, and if any comparison could be made with the flora of glaciated regions on similar geologic formations.

Of further scientific appeal is the statement by the great Alaskan geologist, Brooks (1953) that "Geologically as geographically Alaska is the meeting point of the Old World and the New. The northwesterly trend of the axis of folding is North American, the southwesterly trend is Asiatic." He also speaks of the deposit of Asiatic rather than American fossils during one of the periods of submergence. Steere (1953), discussing the distribution of arctic bryophytes, points out that Alaska is the region richest in circumpolar arctic species and, together with northwestern Canada is "an area of critical geographical significance, where . . . "bicentric" species might be expected to find a common meeting place." Our

[1] Field work done under the auspices of the Arctic Institute of North America, with funds provided by the Office of Naval Research.

Later assistance was received in the form of a grant from The National Science Foundation.

region is subarctic rather than arctic, but the extreme richness of my collections, as far as I have examined them, including, apparently, many relict species, points it out as a very important area.

In 1951 two of us, Mrs. E. A. Sherrard, also of Hanover, N. H., and I received a grant from the Arctic Institute of North America which enabled us to spend all of July and August in Alaska, collecting freshwater algae and mosses.

Advised by geologists we chose two focal areas. One was in Mount McKinley National Park at the southern fringe of the central unglaciated band, where we could collect, presumably, in glaciated and unglaciated areas. The algae collected in this area have not yet been studied. A second focal area was chosen at the northern limit of the central unglaciated band, in the Bettles-Wiseman region, in the Koyukuk River valley, a little north of the Arctic Circle. (Plate II).

Alatna (Allakaket) and Bettles are situated on the Koyukuk River, Wiseman is on its Middle Fork, and Nolan lies in the hills to the northwest, on Wiseman Creek (Plate II). According to Maddren (1913) at Alatna, Bettles and Wiseman we were collecting on "Unconsolidated Pleistocene deposits (silts, clays, sands and gravels, comprising terrace deposits, glacial outwash and morainal deposits, and including some undifferentiated Recent deposits.)" At Alatna and Bettles the closest highlands, on both sides of the river, consisted of "Limestone, calcareous sandstones, and arkose, with some igneous rocks." At Wiseman the land not overlaid by the unconsolidated Pleistocene deposits consisted of "Birch Creek Schist (Schists of various types, including some limestones, quartzites, and greenstones). Cut by granitic and dioritic dikes. The gold-bearing formation of the region." Nolan, where gold mining is still being carried on, was on this formation.

From Kellogg and Nygard (1951) we learn that the soils can be classified as follows: Alatna and Bettles — "Half bog, Subarctic Brown Forest and Alluvial soil," Wiseman and Nolan — "Mountain Tundra, Subarctic Brown Forest, Tundra, Half Bog and Bog." The whole area was in the region of "discontinuous permafrost." Permafrost has been reported specifically for the Wiseman-Nolan area.

GENERAL ECOLOGY

The whole region is broadly classified as "open white spruce — birch forest." The southern slopes of the Brooks Range form the boundary of two broadly defined physiographic provinces: the Arctic, or Northern Mountain system where tundra prevails, and the Central Valley and Plateau region where boreal forests are established. Bettles and Wiseman seem, therefore, to lie in a transitional area where boreal forest and tundra tend to merge. White spruce, birch and poplar, with an undercover principally of *Ledum*, cover most of the land. Along river banks and levees, and sometimes in moist places at higher altitudes, alder and

willow grow abundantly, with a dominant undercover of *Equisetum*, *Lycopodium* and *Galium spp.* The exposed land about the riverside villages is covered with various grasses and with several species of the saxifrage and rose families. And everywhere the forest is broken by treeless areas of varying extent locally called tundra, some probably better classified as muskeg.

From Alatna, to Bettles, to Wiseman, to Nolan the transition to more northerly, higher land is evident. Alatna and Bettles are more generally wooded. At Wiseman and Nolan there is more brush tundra, including a wider variety of dwarf and creeping woody plants, as well as many herbaceous plants, typical of arctic-alpine or of tundra areas. *Salix reticulata*, *Betula glandulosa*, *Potentilla fruticosa*, *Shepherdia canadensis*, *Ledum groenlandicum*, *Cassiope tetragona*, *Andromeda polifolia*, *Chamaedaphne calyculata* and other species of the heath family are frequent at Wiseman and less frequent or lacking at Bettles.

Stoeckeler (1949), has summarized from the U. S. Weather Bureau and the U.S. Army and Navy some climatological data for two of our villages which indicates the general nature of the region:

	Mean Annual Temp. °F.	Days of Annual Freezing Temp.	Mean Annual Precip. (inches)	Mean Annual Snowfall (inches)	Mean Temp. during J-J-Aug. 1946
Wiseman	21.9°	252	8.82	?	54.6°
Allakaket	18.9°	257	12.95	77	55.8°

The August of 1951, when we were in this region, happened to be unusually wet and it rained nearly every day. This made algae collecting much less profitable toward the end of the period because the ponds, sloughs, etc. became "drowned out."

TYPES OF LOCALITIES

An attempt has been made to fit my localities into the scheme used by Strøm (1926). The following symbols are used:

1b Subaerial on damp soil
2a Wet rock
3b On stones, branches, etc. in brooks and rivers
3d On inundated ground
4a On stones at the shores of lakes and ponds
4b From the bottom of lakes and ponds
4c On stones, branches or other substrates in quiet water
5c On submerged parts of plants
5d In grass-bound pools and ditches
5e From mosses (by squeezing)
("T" has been added when the collection was made in a tundra "pothole" or "niggerhead pool.")

Few alpine habitates were encountered. The hills and the one mountain that we climbed were exceedingly dry, with good mosses and lichens but very meagre algae.

Running water habitats were limited to a few small brooks and sloughs. The rivers were in flood condition due to much rain and were heavily loaded with gravel, making collecting difficult and unprofitable.

The tundra pot-holes were innumerable, with very cold water, usually with a neutral reaction. These varied greatly in algal content, being sometimes nearly sterile, sometimes paved with sheets of *Nostoc* and little else, sometimes having a rich desmid flora.

No large lakes with sandy shores occurred in our region. Most so-called lakes were shallow ponds, ringed and paved with moss (most frequently *Drapanocladus exannulatus* (Gumb.) Warnst.), less often with grass, sometimes they were large, sedge-choked marshes. Whenever possible squeezings were taken from moss, from submerged plants other than moss, and from bottom vegetation, using a drag. "Plankton" hauls were made by throwing or dragging a small net. From these shallow but cold ponds and marshes, showing a high pH, came the richest yields, predominantly desmids.

pH

The pH was determined colorimetrically with a "Lovibond Comparator" which is designed to discount the color natural to the pond water. The indicators used were Chlorphenol Red, pH 4.8–6.4, Bromthymol Blue, pH 6.0–7.6, and Cresol Red, pH 7.2–8.8. These were newly purchased from Eimer and Amend Co. Their readings have been checked against a Beckman pH meter and been declared to be "very close, as close as a visual method can be."

North of the Arctic Circle, which is the region dealt with in this paper, the pH values were consistently high: from 6.4–8.6 with pH 8.0 being the commonest record for ponds, lakes and marshes. Perhaps this is to be accounted for by the underlying formation which in most cases was partly limestone (although the bodies of water always had a heavy growth of vegetation which might be expected to annul the effect). Perhaps the very cold water is an important factor. At any rate I have faith in my records and the localities that *looked* favorable for desmids proved to be so, in spite of the high pH.

It seems possible that I have here the condition that Steinecke (1928) found, if my region is comparable to his "flat moors." While central Alaska is neither truly arctic or alpine there may be enough permafrost and tundra conditions to support a population in non-acid waters similar to the acid *Sphagnum* associations in warmer regions. Cedergren (1928) points out the agreement between the algae of Ca-rich highland regions and lowland algae in well-aerated water, and says "When the ecology of the algae is better known probably most of the arctic-alpine algae will

show themselves to be more or less calciphiles, or at least to tolerate Ca, which otherwise is not the rule among desmids." [1]

Everything that I am finding supports these statements in reference to our region. When all my material has been examined the lists of species should be long enough to justify my belief that in these subarctic regions desmids are thriving, at a high pH, under conditions eminently suitable for them.

SCOPE OF PRESENT PAPER AND PREVIOUS WORK

At the time of writing the material has been studied only from Alatna, Wiseman, Nolan and one station in Bettles, but it has seemed advisable for greater efficiency in the continuation of the investigation to get something into print now for criticism. This paper will (it is hoped) be followed by subsequent ones treating the rest of the desmids and the other greens, bluegreens and heterokonts of the region. Meanwhile study of the rest of the collection will be continued, and then the material, which is rich in diatoms, will be turned over to the experts in that field. It is to be hoped that eventually something of interest may be revealed about the glaciation problem, desmids in localities of high pH, and the relationship of our flora to that of similar situations in Europe and to relict and arctic-alpine flora.

To the best of my knowledge no reports on freshwater algae have been published for the territory where we collected. The complete (?) list of those who have, to date, published on freshwater Alaskan freshwater algae (exclusive of diatoms and flagellates) is: Blum (1953), Collins (1909), Farlow (1885), Harvey (1872), Hasslow (1934), Hooper (1947), Juday et al (1935), Kol (1942), Lowe (1923), Petersen (1932), Prescott (1953), Saunders (1901), Setchell & Gardner (1903), Sjösted (1939), Wailes (1933) (1934) and Whelden (1947). Those within the scope of the present paper are: Saunders on the southern coast, Lowe on the northern coast, Wailes in the extreme southeast and southwest and Kol on glaciers in the southern mountains. It has been possible to locate their stations quite accurately on the map (Pl. I), so they will be entered as "Saunders (A), (B)," etc, and their records will be added to mine, making the list, as far as it goes, complete, to date, for Alaska.

METHODS

All identifications were made from formalin-preserved material, and the relative abundance indicated by the usual "ccc, cc, c, r, rr" after thorough examination of a number of slides from one sample, using a mechanical stage. This is of course wholly subjective. To me "ccc" means dominant in every slide, "cc" present in nearly every low-power field, "c" many

[1] "Då algernas ekologi blir bättre känd, komma troligen de flesta av de arktisk-alpina visa sig var mer ell mindre kalkalger err åtminstone tåla kalk, vilket eljes ej är regel bland desmidiacéerna."

specimens seen, "r" only a few specimens seen, and "rr" only one or two specimens seen. When no letter follows, no impression as to abundance was noted.

All drawings were made with an Abbé camera lucida, most of them with the mirror mounted separately, about 12 inches from the miscroscope, a system recommended by Mr. A. M. Scott. The degree of magnification on the plates shows a regrettable lack of uniformity because many of the drawings were made while I was experimenting with the proper position for the mirror, and with the lens combination. Some of the details have been magnified two times my means of a simple desk magnifier, on the camera lucida principle. An illustration is furnished for every plant named, since naked lists from an author as little known as the present one are of little value.

In the following pages certain conventions and abbreviations are used. The dimensions refer to the author's Alaskan material only. "L" = length of cell, "w" = width of cell, "th" = thickness of cell, "isth." = width of isthmus in face view, "pyrenoids" = number of pyrenoids per semicell (Chloroplasts and pyrenoids, often doubtful or distorted in preserved material, are represented on the plates by dotted lines.), "terminal granules" = number of granules in the terminal granule. Specimens found by the author are entered as "Alatna: A5–c" etc. Alatna is the nearest village (Pl. I, II), A5 is the station which will be described in the final installment of this paper, –c indicates the relative abundance. Records of other authors are listed with the author's name followed by a letter (Kol–S) etc, which spots the location on the map of Alaska (Pl. I). Latitude, longitude and altitude were determined with the help of a pocket altimeter, a pedometer and the best maps available (usually flight charts), but should be considered only approximate.

LIST OF SPECIES

DESMIDIACEAE

Gonatozygon

Gonatozygon Brébissonii De Bary (Pl. III, Fig. 2).

L. 220 μ, max. w. 7μ (31 ×), w. at apex 5μ, granules sparse, sharp. Alatna: A2–r.

Gonatozygon Brébissonii De Bary var. **tatricum** Raciborski (1885) p. 12 (Pl. III, Fig. 3–5).

L. 75–118 μ, w. 6–8 μ (11–19 ×), pyrenoids 2–6, granules small, sharp. Nolan: N2, N4, Wiseman: W87–r, W88–rr, W95–r.

Probably new for America.

Gonatozygon Kinahani (Arch.) Rab. (Pl. III, Fig. 6–7).

L. 271–350 μ, w. 21–25 μ (13–14 ×), pyrenoids 3–6, as isolated cells or short filaments. Alatna: A5–cc, A6–c.

Our plant has cells much wider than the 14 μ limit given by the Wests. It is too short to be the var. *maius* of Taylor (1934), but it approaches the form described by Grönblad (1920), with cells 228–562 μ × 21–23 μ, with chloroplast often spirally twisted.

Gonatozygon monotaenium De Bary (Pl. III, Fig. 1).
L. 185–192 μ, w. at middle 9–10 μ (19–20.5 ×), w. at apex 10–11 μ, pyrenoids 5–7, granules rather flat, sometimes indistinct. Wiseman: W23–rr, W68.

SPIROTAENIA

Spirotaenia condensata Bréb. (Pl. III, Fig. 8).
L. 158–173 μ, w. 15–19 μ (9.1–10.5 ×), w. at apex 11–13 μ, Alatna: A5–c.

Spirotaenia obscura Ralfs (Pl. III, Fig. 9).
L. 74 μ, w. 14 μ (5.3 ×), w. at apex 6 μ. Wiseman: W90–r.

MESOTAENIUM

Mesotaenium Berggrenii (Wittr.) Lagerh. var. **alaskana** Kol (1942), p. 25.
Reported by Kol (O–S).

Mesotaenium macrococcum (Kütz.) Roy & Biss.
Reported by Saunders (D) (as *M. braunii* De Bary).

ANCYLONEMA

Ancylonema Nordenskiöldii Berggren
Reported by Kol (O–S) (as *Ancyclonema Nordenskioldii* Berggren).

CYLINDROCYSTIS

Cylindrocystis Brébissonii Menegh. (Pl. III, Fig. 10).
L. 34.5–51 μ, w. 16–20 μ (2–3 ×), pyrenoid 1. Alatna: A8–c, Bettles: 297–r, Wiseman: W98–r.

Cylindrocystis Brébissonii Menegh. forma α (Pl. III, Fig. 11–12).
L. 72–96 μ, w. 24–25 μ (3–3.8 ×), pyrenoids 2. Alatna: A7–r.
Dividing cells?

Cylindrocystis Brébissonii Menegh. forma β (Pl. III, Fig. 13).
L. 54 μ, w. 26 μ (2.1 ×), pyrenoid 1. Alatna: A2–r.
A very angular form.

Cylindrocystis Brébissonii Menegh. oic forma **cryophila** Kol (1942), p. 26.
Reported by Kol (O–S).

Cylindrocystis Brébissonii Menegh. var. **minor** W. & G. S. West (Pl. III, Fig. 15).
L. 32.5 μ, w. 13μ (2.5 ×), pyrenoid 1. Wiseman: W80–c.

Cylindrocystis Brébissonii Menegh. var. **turgida** Schmidle. (Pl. III, Fig. 14).
L. 49–52 μ, w. 25–30 μ (1.7–2 ×), pyrenoid 1. Alatna: A2–r, A7–r.

Cylindrocystis crassa De Bary
Reported by Lowe (J). "In large gelatinous masses."

Cylindrocystis crassa De Bary var. **elliptica** W. & G. S. West (Pl. III, Fig. 16).
L. 28 μ, w. 20 μ (1.4 ×). Alatna: A8–r.

NETRIUM

Netrium digitus (Ehrenb.) Itzigs. & Rothe (Pl. III, Fig. 17).
L. 107–110 μ, w. 33–40 μ (2.7–3.2 ×) (Very common, size not always noted). Alatna: A1–c, A3–cc, A5–cc, A6–cc, A7–r, Bettles: 297–cc, 298–cc, Wiseman: W55, W56–c, W57–c, W70–r, W72–rr. Also reported by Saunders (E) (as *Penium Digitus* (Ehr.) Breb.) and by Wailes (1933, 1934) (N).

Netrium digitus (Ehrenb.) Itzigs & Rothe forma α (Pl. III, Fig. 18).
L. 110 μ, w. 40 μ (2.8 ×). Alatna A2–r.
A form approaching var. *curtum* (Borge) Krieger.

Netrium digitus (Ehrenb.) Itzigs. & Rothe var. **rhomboideum** Grönbl. (Pl. III, Fig. 19).

Two specimens seen: One (W70) L. 140 μ, w. 55 μ (2.5 $\times$), w. at apex 20 μ (dimensions very similar to those given to Grönblad); the other (A5) much larger: L. 227 μ, w. 90 μ (2.5 $\times$), w. at apex 30 μ. Alatna: A5–r, Wiseman: W70–r.

Netrium digitus (Ehrenb.) Itzigs. & Rothe var. **lamellosum** (Bréb.) Grönbl. (Pl. III, Fig. 20).
L. 150–154 μ, max. w. 24–39 μ (4–6.2 $\times$), w. at apex 10–11 μ. Alatna: A2–r, A5–r.

Netrium digitus (Ehrenb.) Itzigs. & Rothe var. **lamellosum** (Bréb.) Grönbl. forma α (Pl. III, Fig. 21).
L. 152 μ, max. w. 40–42 μ (3.6–3.8 $\times$), w. at apex 18 μ. Wiseman: W55, W67.
A relatively short form.

Netrium interruptum (Bréb.) Lütkem.
Reported by Saunders (C) (as *Penium interruptum* Bréb.)

Netrium oblongum (De Bary) Lütkem. (Pl. III, Fig. 22).
L. 107 μ, w. 29 μ (3.7 $\times$), w. at apex 20 μ. Alatna: A8–c. Also reported by Saunders (E) (as *Penium oblongum* De Bary), and by Wailes (1933, 1934) (N).

Netrium oblongum (De Bary) Lütkem. var. **brevius** West (Pl. III, Fig. 23).
L. 78 μ, w. 26 μ (3 $\times$), w. at apex 13 μ. Alatna: A8–r.

PENIUM

Penium cruciferum (De Bary) Wittr.
Reported by Lowe (H).

Penium exiguum West. (Pl. III, Fig. 24–25).
L. 38–60 μ, w. 9–10 μ (4.2–10 $\times$), w. at apex 8.5–9.5 μ, w. below apex 8–8.5 μ, pyrenoids 2, wall granulate, granules irregularly arranged, smaller and fainter at isthmus, girdle bands not observed, wall colorless in region of isthmus, shading to dark brown at the apices. Alatna: A5–r.

Our plant differs from the species as described by West (1892) in its larger size and colored cell wall. Krieger extends the size range to beyond our limits, does not mention wall color, and describes and figures the wall as "punctate" (as he does all the "granular" Peniums). With its larger size and colored cell wall our plant fits very well into *P. margaritaceum* forma *minor* Cederg. which Krieger includes in *P. exiguum*.

Penium margaritaceum (Ehrenb.) Bréb.
Reported by Lowe (H), and by Saunders (B).

Penium polymorphum Perty
Reported by Saunders (B).

Penium silvae-nigrae Rabanus forma **minor** Bourrelly and Manguin (1952), p. 492. (Pl. III, Fig. 26–27).
L. 33 μ, w. 16–17 μ (2 $\times$), w. at apex 10 μ, pyrenoid 1, wall colorless, striate, with rather widely-spaced (8 in 10 μ) broken striae, which appear as rows of dashes rather than as punctae. Wiseman: W98–r.

This is closest to Bourrelly and Manguin's form but differs in its shape, with greater taper toward the apex, and in the nature of its striae.

Penium spirostriolatum Barker (Pl. III, Fig. 28).
L. 230–275 μ, w. 20.5–30 μ (9.1–11.2 $\times$), w. at apex 16 μ, transverse sutures very evident, wall yellow, striate, striae 7 in 10 μ, with spiral twist, no punctae visible between the striae. Alatna: A5–c, A6–r. Also reported by Wailes (1933) (M).

Penium spirostriolatum Barker forma α (Pl. III, Fig. 29).
L. 334 μ, w. 38 μ (8.8 $\times$), w. at apex 25 μ, many transverse sutures, wall striate, 4 striae in 10 μ, straight, anastomosing throughout length of cell, clearly punctate between the striae. Alatna: A5.

Bourrelly and Manguin (1946) show a similar form.

CLOSTERIUM

Closterium abruptum West var. **brevius** West & West
Reported by Wailes (1934) (N).

Closterium acerosum (Schrank) Ehrenb. (?) (Pl. VII, Fig. 1).
L. 400–475 μ, w. 32–40 μ (10–14.6 ×), w. at apex 8–9 μ, 25° of arc, pyrenoids 6, terminal granules 2, wall yellow-brown, faintly striated, 5–6 striae in 10μ, striae sometimes becoming irregular at apex. Nolan: N6–r, N8–r, Wiseman: W89–rr. Also reported by Saunders (C), and by Wailes (1934) (N).
Possibly a less-curved form of *Cl. Pritchardianum*?

Cloisterium acerosum (Schrank) Ehrenb. forma α (Pl. VII, Fig. 2).
L. 387 μ, w. 38 μ (10.2 ×), w. at apex 8 μ, nearly straight, wall striate, 5 striae in 10 μ, broken, spirally arranged, merging into irregularly arranged punctae at apex, girdle bands very evident. Nolan: N8.
Superficially this plant resembles *Cl. acerosum* var. *striatum* Hilse, but in the latter there are flat ribs with striae between.

Closterium acerosum (Schrank) Ehrenb. var. **minus** Hantzsch (Pl. VII, Fig. 3).
L. 200–255 μ, w. 18–23 μ (9.7–11.4 ×), w. at apex 4–5 μ, cells nearly straight, ventral wall slightly tumid, pyrenoids 4–6, wall smooth, apices evenly tapered and rounded, not recurved. Alatna: A3–r, A7–rr, Wiseman: W55–rr, W70–rr, W71–rr, W90–r, W91–r, W92–c.
More common than the type.

Closterium acutum Bréb. (Pl. VIII, Fig. 13).
L. 100 μ (2 × the longer semicell), w. 4 μ, (25 ×), w. at apex 1 μ, cells straight, wall smooth, colorless. Alatna: A9–rr. Also reported by Saunders (E).

Closterium angustatum Kütz. (Pl. IV, Fig. 10).
L. 330–540 μ, w. 22–29 μ (13.7–16.5 ×), w. at apex 13 (19) μ, terminal granules many, 1.5–2.5 costae in 10 μ, wall punctate, brown. Apex sometimes bent back and sometimes swollen. Alatna: A5–r, Bettles: 298–r, Wiseman: W69–c, W70–rr. Also reported by Saunders (D) (as *Cl. angustatum* var. *reticulatum* Wolle), and by Wailes (1933) (M).

Closterium angustatum Kütz. forma α (Pl. IV, Fig. 11).
A form about one half as large as the type, wall very rough with punctae. L. 192 μ, w. 9 μ (21.3 ×), w. at apex 7 μ, terminal granule 1, large, 3 costae in 10 μ, sometimes spirally arranged, wall coarsely punctate, yellow. Alatna: A6–r.

Closterium angustatum Kütz. var. **gracilius** var. nov. (Pl. IV, Fig. 12).
Varietas tenuissima, membrana inter costas levi, 233–325 μ long., 8.5–10 μ lat. (27.4–32.5 ×), 6.5–7 μ lat. in apice, costae 3 in 10 μ, membrana brunnea.
A very slender variety with the wall smooth between the costae. L. 233–325 μ, w. 8.5–10 μ (27.4–32.5 ×), w. at apex 6.5–7 μ, 3 costae in 10 μ, wall brown. Rosa (1939) describes a forma *tenuis*, but his is much larger and relatively broader. Alatna: A5, Bettles: 298–r.

Closterium Archerianum Cleve (Pl. IV, Fig. 7).
L. 205–240 μ, w. 21.5–22 μ (9–11 ×), w. at apex 4–5 μ, 120°–130° of arc, pyrenoids 8, striae 6–7 in 10 μ. Alatna: A1–c, Wiseman: W21–r, W22.

Closterium Archerianum Cleve forma α (Pl. IV, Fig. 8).
A form with twice as many striae as the type. L. 223 μ, w. 20 μ (11 ×), apex 4 μ, 125° of arc, pyrenoids 5, 10 striae in 10 μ, wall yellow. Alatna: A2.

Closterium arcuarium Hughes (1952), p. 272. (Pl. V, Fig. 18).
L. 225 μ, w. 21 μ (10.7 ×), w. at apex 4.5 μ, 95° of arc, pyrenoids 5, wall smooth, yellowish. Alatna: A5–rr.
A little larger and somewhat less tumid than Hughes' plant but otherwise very similar.

Closterium Baillyanum Bréb. (Pl. IV, Fig. 9).

L. 560 μ, w. 55 μ (10 ×), w. at apex 26 μ, 25° of arc, terminal granules many, wall punctate, pale brown, darker at apex. Alatna: A5–c.

Closterium cornu Ehrenb. (Pl. VII, Fig. 13).

L. 141 μ, w. 6 μ (23.5 ×), w. at apex 3 μ, about 20° of arc, wall smooth, older semicell brown. Alatna: A6. Also reported by Lowe (H) "Very common . . . the majority were more curved than the type form."

With us it appeared as a rather slender, straight form.

Closterium cornu Ehrenb. forma α (Pl. VII, Fig. 14–15).

L. 160–200 μ, w. 7.2–11 μ (16.3–22 ×), w. at apex 2 μ, cells straight, evenly tapered to the truncate apices, pyrenoids 3–4, terminal granules (seen once) 3, wall colorless, smooth. Wiseman: W17, W78–r, W89–rr.

Closterium costatum Corda (Pl. IV, Fig. 13).

L. 360 μ, w. 40 μ (9 ×), w. at apex 14 μ, 70° of arc, 2 costae in 10 μ, wall yellow, smooth between the costae. Wiseman: W55, W59–r.

Closterium cuspidatum Bail. (Pl. VI, Fig. 18).

L. 153 μ, w. 51 μ (3 ×), w. at apex 14 μ, 195° of arc, pyrenoids 4–5, scattered, terminal granules many, wall smooth, colorless, apex with dorsal hump, terminal spine 9 μ long. Alatna: A5–r.

Closterium cynthia De Not. (Pl. IV, Fig. 6).

L. 100–165 μ, w. 12–20 μ (7.4–11 ×), w. at apex 3.5–4 μ, 135°–165° of arc, pyrenoids 3–5, striae 7–10 in 10 μ, terminal granules (rarely seen) 3–4, wall pale brown. Alatna: A5, A6, Wiseman: W55–r, W90–r.

Closterium cynthia De Not. forma α (Pl. IV, Fig. 4).

A form about twice as large as the type. L. 245 μ, w. 32 μ (7.6 ×), w. at apex 5 μ, 135° of arc, striae 6 in 10 μ, wall colorless. Only empty cell observed. Alatna: A6–c.

Closterium cynthia De Not. forma β (Pl. IV, Fig. 5).

A form with thickened area in wall at apex. L. 140–182 μ, w. 14–20 μ (8–10 ×), w. at apex 3–4 μ, 120°–150° of arc, pyrenoids 4, terminal granules (rarely seen) 5, striae 9–11 in 10 μ, wall colorless to pale brown. Alatna: A9–rr, Wiseman: W78–r, W92.

Closterium dianae Ehrenb. (Pl. V, Fig. 1–6).

L. 145–220 μ, w. 14–21 μ (9–14.7 ×), w. at apex 2–4 μ, 85°–135° of arc, pyrenoids 3–6, terminal granules 1–3, wall smooth, colorless, rarely yellow. Granular thickening in wall at apex ("end pore" of some authors) not always present, but apices usually obliquely truncate. Alatna: A5–cc, A6, A10–rr, Bettles: 297–cc, 298–cc, Wiseman: W20–r, W21–cc, W25–r, W28–r, W29–cc, W71–rr, W83, W84–c, W85, W96–rr. Also reported by Saunders (E) "Only one specimen seen."

A very common and variable species, grading into its varieties and into *Cl. venus*, *Cl. parvulum*, *Cl. tumidulum* and *Cl. Leibleinii*. The minimum length given by West & West of 270 μ is evidently meant to be 170 μ.

Closterium dianae Ehrenb. forma α (Pl. V, Fig. 11–12).

A form more sharply bent near the extremities, approaching var. *compressum* Klebs. L. 78–90 μ, w. 13–16 μ (5.6–6 ×), w. at apex 3 μ, 145°–175° of arc, pyrenoids 2, terminal granule 1, wall smooth, colorless, no granular thickening at apex. Nolan: N6–rr, Wiseman: W101–cc.

Closterium dianae Ehrenb. var. **arcuatum** (Bréb.) Rabenh. (Pl. V, Fig. 7).

L. 127–280 μ, w. 14–37 μ (8–9.1 ×), w. at apex 2–4 μ, 150°–152° of arc, pyrenoids 3–4, terminal granules 5, wall smooth, pale yellow, granular thickening at apex sometimes present. Alatna: A5–c, Wiseman: W72. Also reported by Wailes (1933) (M).

Closterium dianae Ehrenb. var. **brevius** (Wittr.) Petkoff (Pl. V. Fig. 10).

L. 90–139 μ, w. 14–20 μ (6.4–7 ×), w. at apex 2–4 μ, 130°–150° of arc, inner margin slightly swollen, pyrenoids 3–5, terminal granules 3, wall smooth, colorless or

pale yellow, granular thickening at apex rarely present. Nolan: N8, Wiseman: W1–c, W78–r, W101–c.

This seems to grade into *Cl. Leibleinii* var. *minimum* on the thick side and into varieties of *Cl. venus* and *Cl. incurvum* on the small side.

Closterium dianae Ehrenb. var. **minus** (Wille) Schröder (Pl. V, Fig. 8–9).

L. 125–140 μ, w. 10.5–18 μ (8–12 ×), w. at apex 2–3 μ, 100°–125° of arc, pyrenoids 3, terminal granule 1, wall smooth and colorless, granular thickening at apex sometimes present. Alatna: A3, Nolan: N8.

This seems to be an entirely artificial variety including all small forms with concave ventral surface which might be *Cl. dianae*. It grades into *Cl. parvulum* and *Cl. calosporum* (which requires the spore for identification).

Closterium Ehrenbergii Menegh. (Pl. VI, Fig. 20).

L. 395 μ, w. 88 μ (4.4 ×), w. at apex 10 μ, 120° of arc, wall smooth, colorless. Wiseman: W15–rr.

Only one empty cell was seen, but species is unmistakable from its size and shape.

Closterium exile West & West var. **unicrystallatum** Kol (1942), p. 26.

Reported by Kol (S).

Closterium gracile Bréb. (Pl. VIII, Fig. 4, 6).

L. 90–276 μ, w. 4.5–6 μ (18–46 ×), w. at apex 1.8–3 μ, cells straight, incurved toward the apices, pyrenoids 4–7, terminal granules 1–4, wall smooth, colorless to yellow. Alatna: A5–cc, A6, Bettles: 298–r, Wiseman: W69, W70. Also reported by Wailes (1934) (M).

Closterium gracile Bréb. forma **sigmoideum** fa. nov. (Pl. VIII, Fig. 5).

Forma sigmoidea.

L. 185 μ, w. 53 μ (34 ×), w. at apex 3 μ, pyrenoids 7–8, wall smooth, colorless. Alatna: A5–r.

This has probably been seen and figured before, but it is not in the list of sigmoid species in North America given by Irénée-Marie (1954).

Closterium gracile Bréb. var. **tenue** (Lemm.) West & West. (Pl. VIII, Fig. 7).

L. 80 μ, w. 4 μ (20 ×), w. at apex 1.5 μ, 35° of arc, pyrenoids 2 (?), wall smooth, colorless. Alatna: A6–rr.

A rather stout form.

Closterium idiosporum West & West (?) (Pl. VIII, Fig. 9).

L. 240 μ, w. 12 μ (20 ×), w. at apex 2.5 μ, 10° of arc, pyrenoids 5, wall smooth, colorless. Wiseman: W90.

No spore was seen, but the Wests do not seem to consider this essential for identification.

Closterium incurvum Bréb. (Pl. VI, Fig. 5–8).

L. 37–70 μ, w. 7–12 μ (4.2–6.9 ×), w. at apex 1.5–2.5 μ, 175°–200° of arc, pyrenoids 1–3 (usually 2), terminal granule 1, wall smooth, colorless. Alatna: A3–r, A5–r, A6–cc, A7–r, Bettles: 297–cc, 298–cc, Wiseman: W78–rr, W84, W96–r, W99.

This species which was very common and constant in character, with much greater curvature and relatively stouter than *Cl. venus*, seems better kept as a separate species, as is the practice of Grönblad, Irénée-Marie and others.

Closterium incurvum Bréb. forma α (Pl. VI, Fig. 9–10).

A larger and more slender form. L. 82–90 μ, w. 10–12.5 μ (7–8.2 ×), w. at apex 1.8–2.2 μ, 175°–180° of arc, pyrenoids 2–3, terminal granules 2, wall smooth and colorless. Wiseman: W52–c, W78, W85–cc.

Since one specimen shows a granular thickening of the wall at the apex, perhaps this may be a small form of *Cl. dianae* var. *compressum*.

Closterium Jenneri Ralfs (Pl. VI, Fig. 1).

L. 82–90 μ, w. 9–10 μ (9–10 ×), w. at apex 3–4 μ, 120°–150° of arc (difficult to measure), pyrenoids 4, terminal granule 1, wall smooth, even with oil immersion, pale yellow or brown. Alatna: A5, A6, Bettles: 297.

This plant with its smooth (or very finely striated) wall, its blunter apices, and typical curvature, seems better maintained as a separate species rather than a variety of *Cl. cynthia*. This practice is also followed by Grönblad, Irénée-Marie and others.

Closterium Jenneri Ralfs forma α (Pl. VI, Fig. 2).

A small, less-curved form. L. 84 μ, w. 10 μ, (8.4 ×), 110° of arc, pyrenoids 2, terminal granule 1, wall smooth, pale brown. Alatna: A6. Perhaps this is the plant reported by Lowe (H) ". . . a form with apices less curved than type."

Closterium Jenneri Ralfs var. **tenue** var. nov. (Pl. VI, Fig. 3–4).

Varietas tenuis, minus curvata quam planta typica, forma, autem typica, parte media recta, apicibus incurvatis, relative obtusis, 117–143 μ long., 9.5–11 μ lat. (10.6–13.4 ×), 2.5–3 μ in apice, 90°–115° arcus (mensura difficilis), pyrenoidea 2–4, granula terminalia 2, membrana levis, sine colore, raro dilute brunnea.

A slender variety, less curved than the type but with the typical straight middle portion and incurved apical region. Apices also relatively blunt and without a thickened area or pore in the wall. L. 117–143 μ, w. 9.5–11 μ (10.6–13.4 ×), w. at apex 2.5–3 μ, 90°–115° of arc (difficult to measure), pyrenoids 2–4, terminal granules 2, wall smooth, colorless, in one case pale brown. Alatna: A1, A2, Wiseman: W56, W70–r.

Closterium juncidum Ralfs

Reported by Saunders (C).

Closterium juncidum Ralfs var. **brevior** Roy (Pl. IV, Fig. 15).

L. 175 μ, w. 12 μ (14.6 ×), w. at apex 6.5 μ, 35° of arc, 1 large terminal granule, 13 striae in 10 μ. Alatna: A10–r.

Closterium juncidum Ralfs var. **elongatum** Roy & Biss. (Pl. IV, Fig. 16).

L. 350 μ, w. 8.2 μ (42.7 ×), w. at apex 6 μ, 10 striae in 10 μ, wall colorless. Alatna: A9–rr.

Closterium Kuetzingii Bréb. (Pl. IX, Fig. 1).

L. 470 μ, w. 22 μ (21 ×), w. at apex 3 μ, wall striate, 11 striae in 10 μ. Bettles: 297–r, 298–r, Wiseman: W84. Also reported by Wailes (1934) (N).

Closterium Kuetzingii Bréb. var. **laeve** (Racib.) Krieger (Pl. IX, Fig. 2).

L. 420–480 μ, w. 18 μ (23.4–26.7 ×), w. at apex 1.5–2 μ, wall colorless, smooth. Alatna: A3, A9, Wiseman: W83.

Closterium Kuetzingii Bréb. var. **laeve** (Racib.) Krieger forma α (Pl. IX, Fig. 3).

L. 400 μ, w. 21 μ (19 ×), w. at apex 3 μ, wall smooth. Wiseman: W84.

In shape tending toward *Cl. rostratum*.

Closterium Leibleinii Kütz.

Reported by Wailes (1934) (M).

Closterium Leibleinii Kütz. var. **minimum** Schmidle (Pl. VI, Fig. 19).

L. 76–92 μ, w. 15–20 μ (4.7–5.8 ×), w. at apex 2.5–3.5 μ, 141°–155° of arc, pyrenoids 2–3, wall smooth, colorless. Nolan: N8, Wiseman: W1. W80–c.

Krieger absorbs this variety into the species, but makes no allowance in his dimensions for the small size and relative shortness of Schmidle's variety. All of our forms seem closer to Schmidle's description (1893) for var. *minimum* than to the description Krieger gives for *Cl. Leibleinii*.

Closterium libellula Focke

Reported by Saunders (A) (as *Penium closterioides* Ralfs).

Closterium libellula Focke var. **intermedium** (Roy & Bissett) G. S. West (Pl. IV, Fig. 1).

L. 84 μ, w. 15.5 μ (5.4 ×), w. at apex 6 μ, pyrenoids 3. Alatna: A9–r.

Closterium lineatum Ehrenb. (Pl. VIII, Fig. 12).

L. 460–590 μ, w. 20–22 μ (22–28 ×), w. at apex 6–7 μ, cells straight in median portion, slightly incurved toward the apices, pyrenoids 10, terminal granule 1, wall

yellow to dark yellow-brown, striate, 6–9 striae in 10 μ, punctate at apex, in one case punctae observed between the striae. Wiseman: W17–r, W29–c, W72–rr, W94–r.

Closterium lineatum Ehrenb. var. **elongatum** Rosa (1951), p. 200 (Pl. VIII, Fig. 11).

L. 570–665 μ, w. 15–21.5 μ (31–38 $\times$), w. at apex 6.5–7 μ, cells nearly straight, pyrenoids 14, terminal granule 1, 6–9 striae in 10 μ, striae becoming broken at apex but maintaining straight lines, no punctae. Wall of apex with thickened area. Alatna: A9–rr.

Probably the first record for America.

Closterium lunula (Müll.) Nitzsch. (Pl. VII, Fig. 4).

L. 500–600 μ, w. 66–80 μ (6.7–7.6 $\times$), w. at apex 20–27 μ, 33°–45° of arc, pyrenoids many, scattered, wall smooth, colorless, apices slightly recurved. Alatna: A5, Wiseman: W87–r, W88–r, W90–r, W92–cc, W94–cc. Also reported by Saunders (B) "Occasional."

Closterium lunula (Müll.) Nitzsch. forma **gracilis** Messik. (1935), p. 119. (Pl. VII, Fig. 5).

L. 610 μ, w. 95 μ (6.4 $\times$), w. at apex 28 μ, 35° of arc, pyrenoids many, scattered, terminal granules many, small, wall smooth, colorless, chloroplast with longitudinal plates (6 visible in surface view) notched in the manner of *Netrium digitus*. Bettles: 298–rr.

Our plant differs from Messikommer's in its slightly tumid ventral surface, making it more nearly symmetrical, and in its larger dimensions. However, the chloroplast plates with notched edges, the less recurved apices and smooth wall seem to fit most closely into his form. An end vacuole with many small granules is very evident in our plant. Very similar is *Cl. lunula* var. *carinthiacum* Beck-Mannagetta (1931), p. 266, figured by Irénée-Marie (1954), which, however, lacks the terminal vacuole (or "Endblase" (?)) which is so conspicuous in our plant and in Messikommer's. Similar also is *Cl. lunula* var. *Massartii* (de Wild.) Krieger, which is, however, more nearly symmetrical, somewhat larger, and has less dissected chloroplast plates. Perhaps these three could be combined as one variety of *Cl. lunula*.

Closterium macilentum Bréb.

Reported by Saunders (D) (as *Cl. Brébissonii* Delp.).

Closterium moniliferum (Bory) Ehrenb. (Pl. VI, Fig. 21).

L. 220–305 μ, w. 30–41 μ (6.3–7.6 $\times$), w. at apex 7–8 μ, 70°–100° of arc, pyrenoids 4–8, terminal granules many, wall smooth, colorless. Wiseman: W74–r, W80–r, W89–c, W91–cc, W92–cc, W94–c. Also reported by Lowe (H).

Closterium moniliferum (Bory) Ehrenb. var. **concavum** Klebs. (Pl. VI, Fig. 22).

L. 238–250 μ, w. 37–43 μ (6.4–6.8 $\times$), w. at apex 7–8 μ, 115°–120° of arc, pyrenoids 5–6, terminal granules 4, wall smooth, pinkish brown. Wiseman: W78–r.

Closterium navicula (Bréb.) Lütkem. (Pl. IV, Fig. 2–3).

L. 47–86 μ, w. 12–17.5 μ (3.9–4.9 $\times$), w. at apex 5–6.5 μ, pyrenoid 1. Alatna: A1, A3–r, A5–cc, A6–c, Wiseman: W55–r, W90.

Closterium parvulum Näg. (Pl. V, Fig. 13–17).

L. 92–140 μ, w. 10.5–18 μ (7–11 $\times$), w. at apex 2–3 μ, 120°–165° of arc, pyrenoids 2–5, terminal granules 1–5, wall smooth, colorless, rarely pale brown. Alatna: A2, A3, A5–cc, A9–rr, Bettles: 297–r, Wiseman: W21–cc, W28–r, W42, W49–cc, W55–r, W56, W59–c, W70, W76, W78. Also reported by Lowe (H,K), and by Saunders (C) "very abundant."

Another very common and variable species, grading into varieties of *Cl. dianae* and *Cl. venus*. Separation in this paper has been made mainly on the basis of *Cl. parvulum* having a greater curvature and sharper apices than *Cl. dianae*, and a lesser curvature and larger size than *Cl. venus*. The presence of a granular thickening in the wall at the apex is as variable in *Cl. parvulum* as in *Cl. dianae*, but in general *Cl. parvulum* has an evenly tapered apex while the apex of *Cl. dianae* is obliquely truncated.

Closterium praelongum Bréb. (Pl. VII, Fig. 9).

L. 515 μ, w. 19.5 μ (26.3 ×), w. at apex 6 μ, cell nearly straight, incurved near the apices, with tips recurved, pyrenoids 7, wall very pale brown, striate, 10 striae in 10 μ. Wiseman: W90–rr, W92–rr.

Closterium praelongum Bréb. var. **brevius** West (Pl. VII, Fig. 16).

L. 205–360 μ, w. 17–20 μ (12–18 ×), w. at apex 3.5–5 μ, 25°–35° of arc, apices more or less recurved, pyrenoids 5–11, terminal granules 1–2, wall brownish, finely striated, 11–13 striae in 10 μ. Wiseman: W87–c, W94.

Closterium Pritchardianum Arch. (Pl. VII, Fig. 8).

L. 410 μ, w. 30 μ (13.7 ×), w. at apex 8 μ, 35° of arc, ventral side also concave, wall striate, 6 striae in 10 μ. Alatna: A10.

Closterium Pritchardianum Arch. forma **laeve** Hughes (1952), p. 284 (Pl. VII, Fig. 7).

L. 330–525 μ, w. 30 μ (11–17.5 ×), w. at apex 8–9 μ, 20°–35° of arc, apices abruptly tapered, somewhat recurved, pyrenoids 6–7, wall smooth, colorless. Alatna: A10, Wiseman: W78–r.

Compare *Cl. acerosum*. In my material there is a considerable overlapping of characters between these two species and their varieties.

Closterium pronum Bréb. (Pl. VIII, Fig. 8).

L. 255 μ, w. 11 μ (26.8 ×), w. at apex 2 μ, cells nearly straight, pyrenoids 12, terminal granules 9–10, wall smooth, colorless. Wiseman: W72.

A relatively short form.

Closterium pseudolunula Borge (Pl. VII, Fig. 6).

L. 295–310 μ, w. 38.5–44 μ (7–7.6 ×), w. at apex 8 μ, 65° of arc, pyrenoids 4, in median row, terminal granules 6–8, wall smooth, yellow. Wiseman: W21–c.

Closterium Ralfsii Bréb. var. **hybridum** Rabenh. (Pl. VIII, Fig. 10).

L. 465 μ, w. 38 μ (12 ×), w. at apex 8 μ, 38° of arc, 10 striae in 10 μ, wall brown. Wiseman: W83–rr. Also reported by Wailes (1934) (N).

Closterium rostratum Ehrenb. (Pl. IX, Fig. 4–5).

L. 360–440 μ, w. 20–40 μ (9.3–19.3 ×), w. at apex 2–2.5 μ, apex sometimes swollen, wall brown, striate, 7–12 striae in 10 μ, wall sometimes thickened at apex. Alatna: A3, A10–r, Nolan: N8–r, Wiseman: W21–r, W29–rr, W72–rr, W78–r, W85–rr. Also reported by Wailes (1933) (M) (as *Cl. rostratum* var. *brevirostratum* West).

This was by far the commonest of the beaked Closteriums and showed considerable variation.

Closterium setaceum Ehrenb. (Pl. IX, Fig. 6).

L. 330–480 μ, w. 11–18 μ (26.7–33 ×), w. at apex 2.5 μ, wall delicately striate, 13 striae in 10 μ. Alatna: A2–rr, A5–cc, A6–r. Also reported by Lowe (H), and by Wailes (1934) (N).

Closterium strigosum Bréb. var. **elegans** (G. S. West) Krieger (Pl. VIII, Fig. 3).

L. 195 μ, w. 7.5 μ (26 ×), w. at apex 2 μ, wall smooth, colorless. Alatna: A2–rr.

This is more slender than the 11–21 μ allowed in the dimensions given by Krieger, but he includes in this variety *Cl. strigosum* forma of Schmidle (1902) which has the breadth of only 5 μ.

Closterium striolatum Ehrenb. (Pl. IV, Fig. 14).

L. 250–260 μ, w. 23–24 μ (11 ×), w. at apex 9–10 μ, 60° of arc, pyrenoids 4–7, wall striate, 5–7 striae in 10 μ, pale brown. Alatna: A3–r, A6–r, Wiseman: W29. Also reported by Lowe (H), by Saunders (B), and by Wailes (1933), (M).

Closterium toxon W. West (Pl. VIII, Fig. 1–2).

L. 200–205 μ, w. 14–15 μ (13.7–14.3 ×), w. at apex 7 μ, 20°–35° of arc, pyrenoids 3, terminal granule 1, wall smooth, colorless to yellow, apices slightly incurved, in one case a little swollen. Alatna: A1, Bettles: 297.

Closterium tumidulum Gay (Pl. V, Fig. 19–20).

L. 102–132 μ, w. 15–18 μ (6.5–7.3 ×), w. at apex 2–3 μ, 130°–150° of arc, pyrenoids 2–7, 1 large or many small terminal granules, wall smooth, colorless. Wiseman: W80, W92.

Our plants are less tumid, with less attenuated apices than those figured by Krieger, but Borge (1901) shows a form rather like ours.

Closterium tumidum Johnson (Pl. VII, Fig. 11–12).

L. 162–165 μ, w. 19 μ (8.5–8.7 ×), w. at apex 4–5 μ, 20°–30° of arc, pyrenoids 2–3, wall smooth, colorless. Alatna: A1.

Closterium tumidum Johnson forma α (Pl. VII, Fig. 10).

L. 180 μ, w. 19 μ (9.5 ×), w. at apex 3 μ, straight, pyrenoids 5, terminal granule 1. Alatna: A3.

A form longer than the type, cells straight and more tapered.

Closterium venus Kütz. (Pl. VI, Fig. 11).

L. 56–85 μ, w. 8–10 μ (7–9.4 ×), w. at apex 1.2–1.9 μ, 150° of arc, pyrenoids 2, terminal granules 2 (rarely observed), wall smooth, colorless, rarely yellowish. Wiseman: W28, W72–c, W78–c. Also reported by Lowe (H) "Fairly common," and by Saunders (C).

Much rarer than *Cl. incurvum* or *Cl. venus* var. *crassum*.

Closterium venus Kütz. forma α (Pl. VI, Fig. 17).

L. 78–80 μ, w. 10–11 μ (7.3–7.8 ×), w. at apex 1.8–2 μ, 170° of arc, pyrenoids 2, terminal granules 2, wall smooth, colorless. Wiseman: W52, W87–r.

A form between *Cl. venus* and the large form of *Cl. incurvum*.

Closterium venus Kütz. forma **maior** Strøm (Pl. VI, Fig. 15–16).

L. 100–125 μ, w. 15–20 μ (6.3–6.7 ×), w. at apex 3–4 μ, 150°–160° of arc, pyrenoids 3–4, terminal granules 3 (?) (seen only once), wall smooth, colorless. Wiseman: W21, W57–r.

Krieger absorbs Strøm's form into *Cl. parvulum*, which is not unreasonable considering his figure which shows a curvature of only about 120° of arc. However, our specimens fit Strøm's description and have a curvature of 150°–160° of arc, which is better for *Cl. venus* than for *Cl. parvulum*, so it seems more appropriate to include them in Strøm's form.

Closterium venus Kütz. var. **crassum** var. nov. (Pl. VI, Fig. 12–14).

Varietas crassior, magis curvata, 76–92 μ long., 13–15.5 μ lat. (5–6.4 ×), 2–3 μ lat. in apice, 140°–170° arcus, pyrenoidea 1–5 (plerumque 2), granula terminalia 1–4, membrana levis, sine colore.

L. 76–92 μ, w. 13–15.5 μ (5–6.4 ×), w. at apex 2–3 μ, 140°–170° of arc, pyrenoids 1–5 (commonly 2), terminal granules 1–4, wall smooth, colorless. Alatna: A1, A2–cc, A3–cc, A4–r, Nolan: N6–r, N8, Wiseman: W21–c, W28–r, W76–c, W78.

A much stouter, more strongly curved variety. This was a very common form, occurring in abundance in many of the collections. Grönblad, 1952, Mem. Soc. Fauna Flora Fenn. 28:51, figures a somewhat similar form.

PLEUROTAENIUM

Pleurotaenium coronatum (Bréb.) Rabenh.

Reported by Wailes (1933) (M).

Pleurotaenium Ehrenbergii (Bréb.) De Bary (Pl. X, Fig. 1).

L. 380–500 μ, w. at basal swelling 26–35 μ (16.3–17 ×), w. at apex 18–21 μ, 3–5 (6) tubercles visible across the apex, wall colorless, punctate. Alatna: A2–c, A9–r, A10, Bettles: 298–r, Wiseman: W17, W25–r, W28–c, W52–r, W55–c, W57, W70–r, W72–c, W74, W78–r, W85c. Also reported by Wailes (1933) (M), and (1934), (N).

Pleurotaenium Ehrenbergii (Bréb.) De Bary forma α (Pl. X, Fig. 2).

L. 356–420 μ, w. at basal swelling 27–29 μ, max. w. 29–31 μ (11.7–13.5 ×), w. at

apex 19–22 μ, 4 tubercles visible across apex, semicell slightly swollen in mid-region, wall colorless, punctate, pores irregular, faint, *elongate*. Wiseman: W84–c.

This relatively short form with swollen semicells is closest to var. *tumidum* Turner which Krieger includes in the species. The elongate pores seem unique.

Pleurotaenium Ehrenbergii (Bréb.) De Bary var. **curtum** Krieger (Pl. X, Fig. 3).

L. 210–320 μ (2 $\times$ the longer semicell), w. at basal swelling 30–31 μ (10.7 $\times$), w. at apex 18 μ, 5 tubercles visible across apex, wall colorless, apparently smooth. Wiseman: W85–c.

Pleurotaenium Ehrenbergii (Bréb.) De Bary var. **elongatum** West (Pl. X, Fig. 4).

L. 640 μ, w. at basal swelling 26 μ (24.6 $\times$), w. at apex 19–20 μ, 5 prominent tubercles visible across apex, wall colorless, sparsely punctate. Wiseman: W59.

Pleurotaenium eugeneum (Turn.) West & West (Pl. IX, Fig. 7).

L. 890 μ, w. at basal swelling 40 μ (22.3 $\times$), w. at apex 33 μ, basal swelling prominent, lateral margin undulate throughout length, nearly parallel, apex not swollen, with 11 visible tubercles, wall apparently smooth. Only one specimen seen. Bettles: 298–rr.

Our plant, with its definite undulate margins, approaches var. *undulatum* (Borge) Krieger, but its relative narrowness and few apical tubercles make it fit better into the species, which, according to the Wests, has "slightly sinuate" margins.

Pleurotaenium minutum (Ralfs) Delp. (Pl. X, Fig. 10).

L. 145 μ, w. at basal swelling 13 μ (11.1 $\times$), w. at apex 9 μ, semicell evenly tapered from basal swelling to rounded apex, wall apparently smooth. Alatna: A1–c. Also reported by Saunders (E) (as *Docidium minutum* Ralfs).

Pleurotaenium minutum (Ralfs) Delp. var. **elongatum** (West & West) Cedergren (Pl. X, Fig. 11).

L. 260 μ, w. at basal swelling 9.5 μ (27 $\times$), w. at apex 7 μ, basal swelling very slight, semicell evenly tapered to rounded apex, chloroplast axial (?), with a single row of 8 pyrenoids, wall apparently smooth. Alatna: A5–cc.

Pleurotaenium minutum (Ralfs) Delp. var. **gracile** (Wille) Krieger (Pl. X, Fig. 12).

L. 172–250 μ, w. at basal swelling 11–13 μ (14.3–21.1 $\times$), w. at apex 7–8 μ, basal swelling very slight, semicell evenly tapered to apex which is truncate with rounded corners, chloroplast axial with a single row of 3–6 pyrenoids. Alatna: A1, A2–r, A3–c, A5–cc.

Pleurotaenium nodosum (Bail.) Lund.

Reported by Saunders (A) "Common."

Pleurotaenium trabecula (Ehrenb.) Näg. (Pl. X, Fig. 5).

L. 320–590 μ, w. at basal swelling 21–36 μ (10.6–16.4 $\times$), w. at apex 15–25 μ, slight inflation above basal swelling, sometimes tumid in middle, wall punctate. Alatna: A1, A3–rr, A5–cc, A6–cc, A7–r, Bettles: 298–r, Wiseman: W25–c, W55, W59–c, W70–c, W85–cc, W92–rr. Also reported by Lowe (L) "Three individuals." (as *Pl. trabecula* fa. *clavata* (Kütz.) West.)

Pleurotaenium trabecula (Ehrenb.) Näg. var. **crassum** Wittr. (Pl. X, Fig. 6).

L. 246–450 μ, w. at basal swelling 26–53 μ, max. w. 29–53 μ (6.4–8.5 $\times$), w. at apex 16–25 μ, undulation above basal swelling very slight, or more often absent, semicells usually gradually inflated, reaching maximum width about $\frac{1}{3}$ to $\frac{1}{2}$ way from isthmus to apex. Apex without tubercles, rounded. Wall punctate, colorless, in the smallest plant pinkish. Alatna: A3–rr, Nolan: N6, N8, Wiseman: W78–rr, W83–r, W85–c, W92.

Pleurotaenium trabecula (Ehrenb.) Näg. var. **elongatum** Cedergren forma **scrobiculatum** forma nova (Pl. X, Fig. 7).

Forma membrana scrobiculata. Cellula 760 μ long., 38 μ lat. in inflatione basali, 27 μ lat. in apice rotundato-truncato. Membrana sine colore, scrobiculata, quoque poro intra areolam circularem elavatamque sito.

L. 760 μ, w. at basal swelling 38 μ (20 ×), max. w. above basal swelling 35 μ, w. at apex 27 μ, apex rounded-truncate, cell wall colorless, scrobiculate. Only one specimen seen. Wiseman: W59–rr.

The wall structure is very striking, presenting an appearance unlike anything I have seen in *Pleurotaenium*. The pores are irregularly and rather widely spaced, each pore lying within a circular raised area.

Pleurotaenium trabecula (Ehrenb.) Näg. var. **hirsutum** (Bail.) Krieger (Pl. X, Fig. 8).

L. 394 μ, w. at basal swelling 34 μ, max. w. above basal swelling 35 μ (11.3 ×), w. at apex 20 μ, apex rounded, wall colorless, punctate, with definite extrusions through the pores, giving a spiny appearance. Alatna: A1.

Pleurotaenium trabecula (Ehrenb.) Näg. var. **rectum** (Delp.) West & West (Pl. X, Fig. 9).

L. 264–380 μ, w. at basal swelling 17–22 μ (14.7–17.5 ×), w. at apex 12–14 μ, no undulation above basal swelling, wall apparently smooth. Alatna: A3–c, A5–cc, Wiseman: W59–r.

Pleurotaenium truncatum (Bréb.) Näg. (Pl. IX, Fig. 8).

L. 400 μ, w. at base 47 μ, max. w. 50 μ (8 ×), w. at apex 29 μ, 7 visible flattened tubercles, wall irregularly punctate. Wiseman: 84–rr, 85–rr. Also reported by Lowe (H), and by Saunders (C).

Pleurotaenium truncatum (Bréb.) Näg. var. **crassum** Boldt (Pl. IX, Fig. 9–10).

Only two plants were seen, which were very different but seem to fit here better than anywhere. One (Fig. 9) L. 370 μ, w. at base 75 μ, max. w. 80 μ (4.6 ×), w. at apex 32 μ, had no basal swelling, 4 plainly visible apical tubercles, and an apparently smooth wall. The other (Fig. 10) L. 260 μ, w. at base 35 μ, max. w. 45 μ (5.7 ×), w. at apex 17 μ, had a slight basal swelling, 3 barely visible apical tubercles, and a punctate wall. Wiseman: W78–rr (Fig. 9), W85–r (Fig. 10).

This seems to be a flexible variety. Boldt's original description (1885) does not allow for apical tubercles, the Wests deny them, Krieger illustrates them, Irénée-Marie (1939) says that they may be present or not, more often not, and points out an interesting association of the presence of tubercles on less swollen specimens as an instance of reversion to type.

TRIPLOCERAS

Triploceras gracile Bail.

Reported by Saunders (E) "Common."

TETMEMORUS

Tetmemorus Brébissonii (Menegh.) Ralfs

Reported by Saunders (E) "Frequent."

Tetmemorus Brébissonii (Menegh.) Ralfs var. **minor** De Bary

Reported by Wailes (1934) (N).

Tetmemorus laevis (Kütz.) Ralfs (Pl. X, Fig. 13).

L. 85–110 μ, w. at base 28–29 μ (3–3.8 ×), w. at apex 15μ, punctate with widely and irregularly spaced pores. Alatna: A8–cc. Also reported by Saunders (E, F), and by Wailes (1934) (N).

EUASTRUM

Euastrum abruptum Nordst. forma **minor** West & West

Reported by Wailes (1933) (M).

Euastrum affine Ralfs

Reported by Saunders (G).

Euastrum ansatum Ralfs (Pl. XI, Fig. 4).

L. 70–75 μ, w. 34–41 μ, isth. 12–15 μ, w. at apex 16–17 μ, th. 23 μ. Lateral facial

protuberances very low, wall coarsely punctate. Alatna: A8–c, A10–r. Also reported by Lowe (H), and by Saunders (F).

Euastrum ansatum Ralfs forma *α* (Pl. XI, Fig. 5).

A form with large slits in wall on face of semicell. L. 70 μ, w. 40 μ, isth. 14 μ, w. at apex 17 μ, th. 23 μ. Wall with slit in middle of semicell, triangular on one face, linear on other. Punctae less prominent, not in vertical rows. Alatna: A5–rr.

This is apparently Schaarschmidt's var. *valleculatum* which Krieger puts under the species.

Euastrum ansatum Ralfs var. **dideltiforme** Ducellier (Pl. XI, Fig. 6).

L. 84–90 μ, w. 44–45 μ, isthmus 12–15 μ, w. at apex 20–22 μ, th. 28 μ. Wall with crease from apical notch to central scrobiculation, punctae only slightly vertical in arrangement. Alatna: A5–r, A6.

Euastrum bidentatum Näg. (Pl. XII, Fig. 12, 13).

L. 50–56 μ, w. 30–37 μ, isth. 9.5–11 μ. th. 21–24 μ, wall smooth or punctate. Alatna: A5–c, A7–r, A8–c, A10–r, Wiseman: W65–r, W67, W78–r, W83–r, W84–r, W85–r. Also reported by Lowe (H, L) "the most common species of the genus."

This occurred sparsely in many stations, and showed considerable variation in facial decoration.

Euastrum bidentatum Näg. forma *α* (Pl. XII, Fig. 14).

A large rounded form with lobes much reduced. L. 60–76 μ, w. 37–40 μ, isth. 13–15 μ, th. 27 μ. Central granules a double row of three, lateral granules somewhat radial in arrangement, wall strongly punctate. Wiseman: W52–r, W53, W56–r.

Closest to *forma* of Skuja (1934), which Krieger absorbs in the species.

Euastrum bidentatum Näg. var. **oculatum** (Istv.) Krieger forma *α* (Pl. XII, Fig. 15).

L. 61–70 μ, w. 37–41 μ, isth. 8–10 μ, th. 26 μ. Wiseman: W67, W70–r.

Our form had the lateral depressions of forma *glabrum* of Scott and Prescott (1952), but did not have the smooth central protuberance characterizing that form.

Euastrum binale (Turp.) Ehrenb.

Reported by Lowe (H, I).

Euastrum binale (Turp.) Ehrenb. var. **Grönbladii** Messik. (Pl. XIII, Fig. 7).

L. 13–15 μ, w. 12–13 μ, isth. 4 μ, th. 8 μ. Alatna: A5–c.

Our plant resembles Grönblad's smaller form, without the 4 apical granules.

Euastrum binale (Turp.) Ehrenb. var. **Gutwinskii** Schmidle (Pl. XIII, Fig. 8–9).

L. 24–27 μ, w. 18–19 μ, isth. 5–7 μ, th. 11–12 μ. Alatna: A1, A2–r, Wiseman: W69–r, W70–c. Also reported by Lowe (H).

Euastrum binale (Turp.) Ehrenb. var. **tumoriferum** Kossinsk. (Pl. XIII, Fig. 10).

L. 23 μ, w. 20 μ, isth. 8 μ, th. 16 μ. Alatna: A8–r.

Euastrum Ciastonii Racib. (Pl. XIII, Fig. 2–4).

L. 47–49 μ, w. 25–28 μ, isth. 6–9 μ, th. 17 μ. Facial ornamentation somewhat variable. Alatna: A5–c, A6–r.

Euastrum crassicolle Lund. (Pl. XIII, Fig. 14).

L. 26 μ, w. 16 μ, isth. 7 μ, th. 8 μ. Alatna: A8–r. Apex very square in lateral view.

Euastrum crassicolle Lund. var. **dentiferum** Nordst. (Pl. XIII, Fig. 15).

L. 26 μ, w. 16 μ, isth. 7 μ, th. 8 μ. Alatna: A8–rr.

Very similar to species but with apex more rounded in face view and provided with teeth. Probably new for North America.

Euastrum denticulatum (Kirchn.) Gay. (Pl. XIII, Fig. 11–12).

L. 20–32 μ, w. 18–26 μ, isth. 11–13 μ, th. 5–9 μ. Alatna: A5–c, Bettles: 298–r, Wiseman: W56–r, W71–r. Also reported by Lowe (H).

Our smallest form (fig. 12) has a large, flat granule inside the pair of marginal granules in each lobe, and 3 granules on the central protuberance. This is very close to the plant shown by Prescott & Scott (1945).

Euastrum didelta (Turp.) Ralfs
Reported by Saunders (B), and Wailes (1933, 1934) (N).

Euastrum dubium Näg.
Reported by Lowe (L) "Approaching var. *Snowdoniense* West & West."

Euastrum dubium Näg. forma α (Pl. XII, Fig. 6).
L. 32–36 μ, w. 23–26 μ, isth. 5.5–7 μ, th. 14–18 μ. Small granules within lobes inconspicuous or lacking, one large smooth central protuberance; apical and lower lateral angles usually furnished with a small tooth. Wiseman: W25–c, W27–c, W28–cc, W55–r, W57–r, W59–r, W69–c, W72–c, W87–rr.

Euastrum dubium Näg. forma β (Pl. XII, Fig. 7).
L. 25 μ, w. 18 μ, isth. 5.5 μ. A smaller form, approaching var. *ornatum*, with 1 definite granule within each lobe and 1 large, smooth central protuberance. Alatna: A3.

Euastrum dubium Näg. var. **ornatum** Wolosz. (Pl. XII, Fig. 8).
L. 29–31 μ, w. 21.5–22 μ, isth. 6–7.5 μ, th. 14.5 μ. Our plant lacks the granules within the apical lobes. Wiseman: W70–c, W85–c.

Euastrum dubium Näg. var. **ornatum** Wolosz. forma α (Pl. XII, Fig. 9, 10).
A form with simpler ornamentation. L. 28 μ, w. 19–20 μ, isth. 6 μ, th. 12 μ. Bettles: 297–c, 298–c, Wiseman: W78–rr.

Euastrum dubium Näg. var. **poriferum** Prescott & Scott (1945), p. 237. (Pl. XII, Fig. 11).
L. 34 μ, w. 25 μ, isth. 8 μ, th. 18 μ. Lower lateral lobes more produced, otherwise very similar, with centrally located mucilege pore and coarse punctations over whole cell. Wiseman: W68.

Euastrum elegans (Bréb.) Kütz. (Pl. XIII, Fig. 5–6).
L. 27–34 μ, w. 18–24 μ, isth. 5–7 μ, th. 13.5–14 μ. Alatna: A5–c, A6–r, Bettles: 297–c, 298–c, Wiseman: W55, W59, W67, W68–cc, W69–c, W70–c. Also reported by Lowe (H) "Several ponds," and by Saunders (A, E, F) "Common in freshwater."
A very common species.

Euastrum erosum Lund. var. **granulosum** Cedercreutz (Pl. XIII, Fig. 1).
L. 46 μ, w. 25 μ, isth. 9 μ, th. 18 μ. Alatna: A8–r.

Euastrum evolutum (Nordst.) West & West var. **integrius** West & West forma **turgidum** Scott & Prescott (1952), p. 381 (Pl. XII, Fig. 3).
L. 54–60 μ, w. 33–35 μ, isth. 9–12 μ, th. 20–22 μ. Wall punctate. Alatna: A3–r, A7–c.
Except for the distinctly punctate wall and pair of scrobiculations above the central protuberance, this closely resembles *E. quebecense* of Irénée-Marie (1939).

Euastrum gemmatum Bréb.
Reported by Saunders (C), and by Wailes (1933) (M).

Euastrum insulare (Wittr.) Roy var. **silesiacum** Grönbl. (Pl. XIII, Fig. 13).
L. 20–22 μ, w. 15–17 μ, isth. 4–6.5 μ, th. 10 μ. Small, relatively short, rounded, upper angles of lateral lobe extending beyond lower angles, slight median inflation. Alatna: A1, A2–c, Bettles: 298–c.
Commoner than the above entries indicate. Since at first, distinction was not made between the species and this variety the records lacking figures are omitted.

Euastrum lapponicum Schmidle (Pl. XII, Fig. 4).
L. 37–40 μ, w. 23–26 μ, isth. 8–9 μ, th. 15–20 μ. The smaller granules on apical and basal lobes usually lacking. Alatna: A5–r, A6–r, Bettles: 297–r, 298–r.

Euastrum lapponicum Schmidle forma α (Pl. XII, Fig. 5).
A depressed form. L. 32 μ, w. 24 μ, w. of apex 7 μ, th. 16 μ. Alatna: A5–r.

Euastrum obesum Josh.
Reported by Wailes (1934) (N).

Euastrum obesum Josh. var. **crassum** Prescott & Scott (1945), p. 282. (Pl. XI, Fig. 7).

L. 104–120 μ, w. 53–61 μ, isth. 17–20 μ, th. 38–? μ. All lobes much rounded, wall coarsely punctate. Alatna: A5–c, A6–r, Bettles: 298–r.

Euastrum oblongum (Grev.) Ralfs. (Pl. XI, Fig. 1).

L. 148–164 μ, w. 6.8–8.5 μ, isth. 18–27 μ, th. 32 μ. With or without central scrobiculation, incision between upper lateral lobes and apical lobes sometimes open, sometimes closed, wall widely punctate. Alatna: A5–r, A6–r, Bettles: 298–r, Wiseman: W53–r, W55–r. Also reported by Lowe (H), Saunders (E), and Wailes (1933) (M).

Euastrum oblongum (Grev.) Ralfs forma α (Pl. XI, Fig. 2).

Wall very coarsely punctate (or scrobiculate?). L. 152–170 μ, w. 74–85 μ, isth. 22–25 μ, central scrobiculations 0–3. Alatna: A5, Bettles: 298–r, Wiseman: W70–r, W90–r.

A very striking form. This extra-heavy pitting of the wall occurs in several different species, and perhaps characterizes subarctic forms.

Euastrum pectinatum Bréb. var. **brachylobum** Wittr. (Pl. XI, Fig. 8).

L. 62–79 μ, w. 44–49 μ, isth. 13–15 μ, th. 24–32 μ. Rather variable. Wall usually rather coarsely punctate, with radial pattern on apical lobe in apical view. Alatna: A5–r, Wiseman: W13, W14.

Euastrum pectinatum Bréb. var. **rostratum** Taylor. (Pl. XI, Fig. 9).

L. 65–71 μ, w. 46–52 μ, isth. 11–13 μ, th. 30–31 μ. Wall evenly, coarsely punctate with larger punctae at apex. Wiseman: W55–r, W59–r, W67, W70–r, W78.

Variable, grading into var. *brachylobum*.

Euastrum pulchellum Bréb.

Reported by Wailes (1933, 1934) (M, N).

Euastrum sinuosum Lenorm. var. **scrobiculatum** Nordst. (Pl. XI, Fig. 3).

L. 80–86 μ, w. 46–47 μ, isth. 13–14 μ, th. 28–33 μ. Each facial protuberance pierced by scrobiculation, also 3 scrobiculations between them. Alatna: A5–c.

Krieger does not figure scrobiculations in facial protuberances, but he notes this as a characteristic of the species.

Euastrum tetralobum Nordst. (Pl. XI, Fig. 10).

L. 86–87 μ, w. 62–63 μ, isth. 20 μ. Alatna: A8–r. Less deeply dissected than the type.

This is usually considered to be a "truly arctic species."

Euastrum Turneri West (Pl. XII, Fig. 1, 2).

L. 37–40 μ, w. 27–29 μ, isth. 8–9 μ, th. 17–18 μ. Alatna: A5, A6, Bettles: 298–r. No two are alike in facial markings.

Euastrum validum West & West forma α (Pl. XIII, Fig. 16).

With two small protuberances, 1 above and 1 below the central scrobiculation. L. 25–28 μ, w. 18–20 μ, isth. 5 μ, th. 9.5–11 μ. Alatna: A5–c, A6–c, Bettles: 298–r.

Euastrum verrucosum Ehrenb. (Pl. XI, Fig. 11).

L. 88–89 μ, w. 72–76 μ, isth. 19–23 μ, th. 48 μ. Lobes rather extended, sinus closed for less than one half its length, then widely open. Wiseman: W29–r, W72–r. Also reported by Saunders (A).

Our form approaches var. *alatum* Wolle but the basal angles do not bend back toward the middle to cause "hooked appearance."

Euastrum verrucosum var. **reductum** Norst.

Reported by Wailes (1933, 1934) (M, N).

Euastrum verrucosum Ehrenb. 2 unnamed varieties.

Reported by Wailes (1933, 1934) (M, N).

Euastrum sp.? (Pl. XIII, Fig. 17).

L. 52 μ, w. 31 μ, isth. 10 μ, th. 21 μ. Cells medium-sized, about 1.7 × longer than broad, deeply constricted, sinus closed, semicell pyramidate, basal angles subrectangular, apex strongly convex, with deep narrow median incision. Semicell with 5 large, smooth protuberances, one within each apical lobe, one within lower angle of

each basal lobe and one in the middle below a pair of mucilege pores. Small tooth at each angle of basal lobe. Wall smooth. Alatna: A7–rr.

This seems quite new, but since only 1 specimen was seen I hesitate to describe a new species.

Euastrum sp.? (Pl. XIII, Fig. 18).

L. 62 μ, w. 42 μ, isth. 15 μ, th. 26 μ. Semicell divided by narrow incisions into 4 not quite equal lobes. Isthmus deep and narrow. One smooth, squarish, central protuberance. Wall smooth. Nolan: N2–rr. (Only one specimen seen.)

This is also *Micrasterias*-like. Possibly it is teratological.

LIST OF SPECIES — ECOLOGICAL

Collected by the author between the 3rd and 17th of August, 1951

	North Latitude	Altitude in feet	pH	Type of Locality
Gonatozygon Brébissonii	66° 34′	400	8.0	5b
G. — var. tatricum	67° 25′–28′	2110–2210	7.0–8.6	4c, 5c, cT
G. Kinahani	66° 33′	400	8.0	5c, e
G. monotaenium	67° 27′–28′	2050	8.0	3b, 5c
Spirotaenia condensata	66° 33′	400	8.0	5e
S. obscura	67° 27′	2110	7.7	4c, 5c
Cylindrocystis Brébissonii	66° 33′–67° 24′	400–4500	7.0	2a, 3d, 5c
C. — forma α	66° 33′	400	8.0	5c
C. — forma β	66° 34′	400	8.0	5b
C. — var. minor	67° 27′	2110	7.2	3b
C. — var. turgida	66° 33′–34′	400	8.0	5b, c
C. crassa var. elliptica	66° 33′	400	—	3d
Netrium digitus	66° 33′–67° 27′	400–2050	6.9–8.0	5b, c, e
N. — forma α	66° 34′	400	8.0	5b
N. — var. lamellosum	66° 33′–34′	400	8.0	5b, e
N. — var. — forma α	67° 25′–27′	2000–2050	6.9–8.0	5c, e
N. — var. rhomboideum	66° 33′–67° 27′	400–2050	8.0	5e
N. oblongum	66° 33′	400	—	3d
N. — var. brevius	66° 33′	400	—	3d
Penium exiguum	66° 33′	400	8.0	5e
P. silvae-nigrae f. minor	67° 24′	4500	—	2a
P. spirostriolatum	66° 33′	400	8.0	5c, e
P. — forma α	66° 33′	400	8.0	5e
Closterium acerosum (?)	67° 27′–28′	2110–2200	7.0–7.7	4c, 5c, cT, dT
Cl. — forma α	67° 28′	c. 2200	—	5dT
Cl. — var. minus	66° 33′–67° 27′	400–2110	6.9–8.0	4c, 5b, c, e
Cl. acutum	66° 33′	400	8.0	5b
Cl. angustatum	66° 33′–67° 27′	400–2050	7.0–8.0	5c, e
Cl. — forma α	66° 33′	400	8.0	5c
Cl. — var. gracilius	66° 33′–55′	400–665	7.0–8.0	5c, e
Cl. Archerianum	66° 34′–67° 28′	400–2050	8.0	3b, 5e
Cl. — forma α	66° 34′	400	8.0	5b
Cl. arcuarium	66° 33′	400	8.0	5e
Cl. Baillyanum	66° 33′	400	8.0	5e
Cl. cornu	66° 33′	400	8.0	5c
Cl. — forma α	67° 27′–28′	2030–2110	7.7–8.1	4c, 5b, c, e
Cl. costatum	67° 25′	2000	6.9	5c, e
Cl. cuspidatum	66° 33′	400	8.0	5e
Cl. cynthia	66° 33′–67° 27′	400–2110	6.9–8.0	5c, e
Cl. — forma α	66° 33′	400	8.0	5c
Cl. — forma β	66° 33′–67° 27′	400–2110	7.7–8.0	4c, 5a, b, c, e
Cl. dianae	66° 33′–67° 28′	400–2210	7.0–8.2	3b, 4c, 5c, cT, e, eT
Cl. — forma α	67° 25′–28′	2020–2200	—	5cT
Cl. — var. arcuatum	66° 33′–67° 27′	400–2050	8.0	5c, e
Cl. — var. brevius	67° 25′–28′	2000–2200	8.0	3d, 5cT, dT, e
Cl. — var. minus	66° 34′–67° 28′	400–2200	8.0	5b, dT
Cl. Ehrenbergii	67° 28′	2050	8.1	5e
Cl. gracile	66° 33′–67° 27′	400–2050	7.0–8.0	5c, e

	North Latitude	Altitude in feet	pH	Type of Locality
Cl. — forma sigmoideum	66° 33′	400	8.0	5e
Cl. — var. tenue	66° 33′	400	8.0	5c
Cl. idiosporum (?)	67° 27′	2110	7.7	4c, 5c
Cl. incurvum	66° 34′–67° 27′	400–2210	7.0–8.0	5b, c, cT, e, eT
Cl. — forma α	67° 24′–27′	2000–2110	7.4–8.0	5c, e, eT
Cl. Jenneri	66° 33′–55′	400–665	7.0–8.0	5c, e
Cl. — forma α	66° 33′	400	8.0	5c
Cl. — var. tenue	66° 34′–67° 27′	400–2050	6.9–8.0	5b, e
Cl. juncidum v. brevior	66° 33′	400	—	4c
Cl. — var. elongatum	66° 33′	400	8.0	5b
Cl. Kuetzingii	66° 55′–67° 27′	665–2110	7.0	5c, eT
Cl. — var. laeve	66° 33′–67° 27′	400–2110	7.0–8.0	5b, eT
Cl. — var. — forma α	67° 27′	2110	7.0	5eT
Cl. Leibleinii v. minimum	67° 25′–28′	2000–2200	7.2–8.0	3b, d, 5dT
Cl. libellula v. intermedium	66° 33′	400	8.0	5b
Cl. lineatum	67° 27′–28′	2050–2110	7.1–8.1	4c, 5b, c
Cl. — var. elongatum	66° 33′	4000	8.0	5b
Cl. lunula	66° 33′–67° 27′	400–2110	7.0–8.0	4c, 5c, e
Cl. — forma gracilis	66° 55′	665	7.0	5c
Cl. moniliferum	67° 27′	2040–2110	7.2–7.7	3b, 4c, 5c, e
Cl. — var. concavum	67° 27′	2030	8.0	5e
Cl. navicula	66° 33′–67° 27′	400–2110	6.9–8.0	4c, 5b, c, e
Cl. parvulum	66° 33′–67° 28′	400–2050	6.4–8.2	3b, 5b, c, e, eT
Cl. praelongum	67° 27′	2110	7.7	4c, 5c
Cl. — var. brevius	67° 27′	2110	7.7	4c, 5c
Cl. Pritchardianum	66° 33′	400	8.0	4c
Cl. — forma laeve	66° 33′–67° 27′	400–2030	8.0	4c, 5e
Cl. pronum	67° 27′	2050	8.0	5c
Cl. pseudolunula	67° 28′	2050	—	3b
Cl. Ralfsii var. hybridum	67° 27′	2110	7.0	5eT
Cl. rostratum	66° 33′–67° 28′	400–2110	7.0–8.0	3b, 4c, 5b, c, dT, e, eT
Cl. setaceum	66° 33′–34′	400	8.0	5b, c, e
Cl. strigosum v. elegans	66° 34′	400	8.0	5b
Cl. striolatum	66° 33′–67° 27′	400–2050	7.1–8.0	5b, c, e
Cl. toxon	66° 34′–55′	400–665	7.0–8.0	5c, e
Cl. tumidulum	67° 27′	2110	7.2–7.7	3b, 4c, 5c
Cl. tumidum	66 ° 34′	400	8.0	5e
Cl. — forma α	66 ° 34′	400	8.0	5b
Cl. venus	67° 27′	2030–2050	8.0–8.2	5c, e
Cl. — forma	67° 24′–27′	2000–2110	7.4–7.7	4c, 5c
Cl. — forma maior	67° 25′–28′	2000–2050	6.9	3b, 5b
Cl. — var. crassum	66° 34′–67° 28′	400–2200	7.0–8.2	3b, d, 5b, c, cT, d, dT, e
Pleurotaenium Ehrenbergii	66° 33′–67° 28′	400–2110	6.9–8.2	4c, 5b, c, e, eT
Pl. — forma α	67° 27′	2110	7.0	5eT
Pl. — var. curtum	67° 27′	2110	7.0	5eT
Pl. — var. elongatum	67° 25′	2000	6.9	5c
Pl. eugeneum	66° 55′	665	7.0	5c
Pl. minutum	66° 34′	400	8.0	5e

	North Latitude	Altitude in feet	pH	Type of Locality
Pl. — var. elongatum	66° 33′	400	8.0	5e
Pl. — var. gracile	66° 33′–34′	400	8.0	5b, e
Pl. trabecula	66° 33′–67° 28′	400–2110	6.9–8.2	4c, 5b, c, e, eT
Pl. — var. crassum	66° 34′–67° 28′	400–2110	7.0–8.0	4c, 5b, c, cT, dT, e, eT
Pl. — var. elongatum forma scrobiculatum	67° 25′	2000	6.9	5c
Pl. — var. hirsutum	66° 34′	400	8.0	5e
Pl. — var. rectum	66° 33′–67° 25′	400–2000	6.9–8.0	5b, c, e
Pl. truncatum	67° 27′	2110	7.0	5eT
Pl. — var. crassum	67° 27′	2030–2110	7.0–8.0	5e, eT
Tetmemorus laevis	66° 33′	400	—	3d
Euastrum ansatum	66° 33′	400	—	3d, 4c
E. — forma α	66° 33′	400	8.0	5e
E. — var. dideltiforme	66° 33′	400	8.0	5c, e
E. bidentatum	66° 33′–67° 27′	400–2110	7.0–8.0	3d, 4c, 5c, e, eT
E. — forma α	67° 24′–25′	2000	6.9–7.4	5c, e
E. — var. oculatum	67° 27′	2050	8.0	5c, e
E. binale var. Grönbladii	66° 33′	400	8.0	5e
E. — var. Gutwinskii	66° 34′–67° 27′	400–2050	8.0	5b, c, e
E .— var. tumoriferum	66° 33′	400	—	3d
E. Ciastonii	66° 33′	400	8.0	5c, e
E. crassicolle	66° 33′	400	—	3d
E. — var. dentiferum	66° 33′	400	—	3d
E. denticulatum	66° 33′–67° 27′	400–2050	6.9–8.0	5c, e
E. dubium forma α	67° 25′–28′	2000–2110	6.9–8.2	4c, 5b, c, e
E. — forma β	66° 34′	400	8.0	5b
E. — var. ornatum	67° 27′	2050–2110	7.0–8.0	5e, eT
E. — var. — forma α	66° 55′–67° 27′	665–2030	7.0–8.0	5c, e
E. — var. poriferum	67° 27′	2050	8.0	5c
E. elegans	66° 33′–67° 27′	400–2050	6.9–8.0	5e, c
E. erosum var. granulosum	66° 33′	400	—	3d
E. evolutum v. integrius forma turgidum	66° 33′–34′	400	8.0	5b, c
E. insulare v. silesiacum	66° 34′–55′	400–665	7.0–8.0	5b, c, e
E. lapponicum	66° 33′–55′	400–665	7.0–8.0	5c, e
E. — forma α	66° 33′	400	8.0	5e
E. obesum var. crassum	66° 33′–55′	400–665	7.0–8.0	5c, e
E. oblongum	66° 33′–67° 25′	400–2000	6.9–8.0	4b, 5c, e
E. — forma α	66° 33′–67° 27′	400–2110	7.0–8.0	4c, 5c, e
E. pectinatum v. brachylobum	66° 33′–67° 28′	400–2050	8.0–8.1	4b, 5c, e
E. — var. rostratum	67° 25′–27′	2000–2050	6.9–8.0	5c, e
E. sinuosum v. scrobiculatum	66° 33′	400	8.0	5e
E. tetralobum	66° 33′	400	—	3d
E. Turneri	66° 33′–55′	400–665	7.0–8.0	5c, e
E. validum forma α	66° 33′–55′	400–665	7.0–8.0	5c, e
E. verrucosum	67° 27′	2050	7.1–8.0	5c
E. sp. (1)	66° 33′	400	8.0	5c
E. sp. (2)	67° 28′	c. 2200	8.6	5c

ACKNOWLEDGEMENTS

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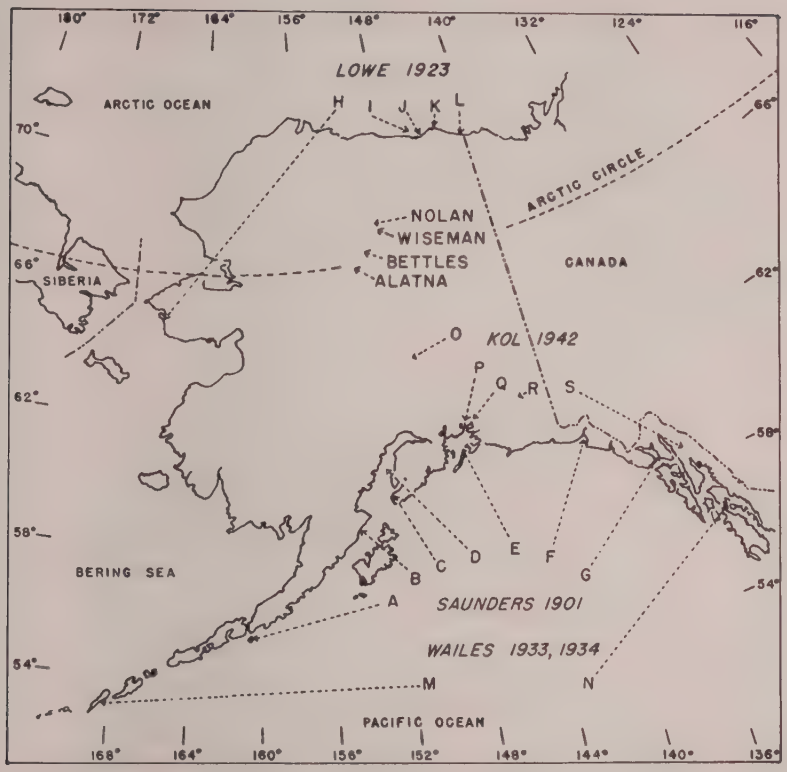
PLATE I

ALASKA



LOCALITIES WHERE ALGAE HAVE BEEN COLLECTED
(WITHIN SCOPE OF THIS PAPER)

SAUNDERS, 1901

A - POPOF ISLAND (c.160°W., 55°N.)

B - KUKAK BAY (c.154°W., 58° 30'N.)

C - SELDOVIA (c.153°40'W., 59°22' N.)

D - COOK INLET (c.152°-154°W., 60°-61°N.)

E - PRINCE WILLIAM SOUND (c.146°-148°W., 60°-61°N.)

F - YAKUTAT BAY (c.139°40'W., 59° 30')

G - GLACIER BAY (c.136°W., 58°30'N.)

LOWE, 1923

H - TELLER (c.166°20'W., 65°15'N.)

I - CAMDEN BAY (c.143-145°W., 70°N.)

J - COLLINSON POINT (144°49'W., 69°59'N.)

K - MARTIN POINT (143°W., 70°08'N.)

L - DEMARCATION POINT (141°12'W., 69°41'N.)

WAILES, 1933, 1934

M - UMNAK ISLAND (c.168°W., 53°N.)

N - PETERSBERG (133°W., 56°50'N.)

KOL, 1942

O - TEKLANIKA GLACIER (c.149° 30'W., 63°25'N.)

P - COLUMBIA GLACIER (c.147°W., 61°N.)

Q - WORTHINGTON GLACIER (c.145°45'W., 61°10'N.)
VALDEZ GLACIER (c.146°15'W., 61°15'N.)

R - KENNICOTT GLACIER (c.143W., 61° 30'N.)

S - MENDENHALL GLACIER (c.134° 33'W., 58°26'N.)

THIS PAPER

ALATNA (c.152°40'W., 66°33'-34'N.)

BETTLES (c.151° 30'W., 66° 55'N.)

WISEMAN (c.150° 03-15'W., 67°24'-28'N.)

NOLAN (c.150°15'W., 67°28'N.)

PLATE II

BEETLES — WISEMAN REGION

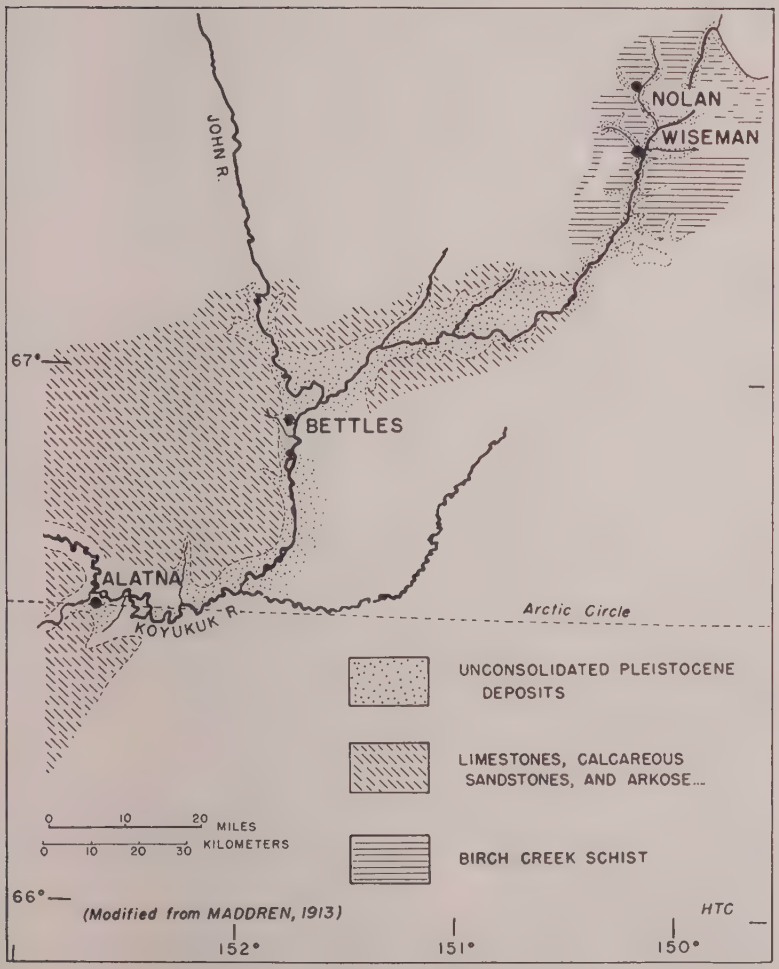
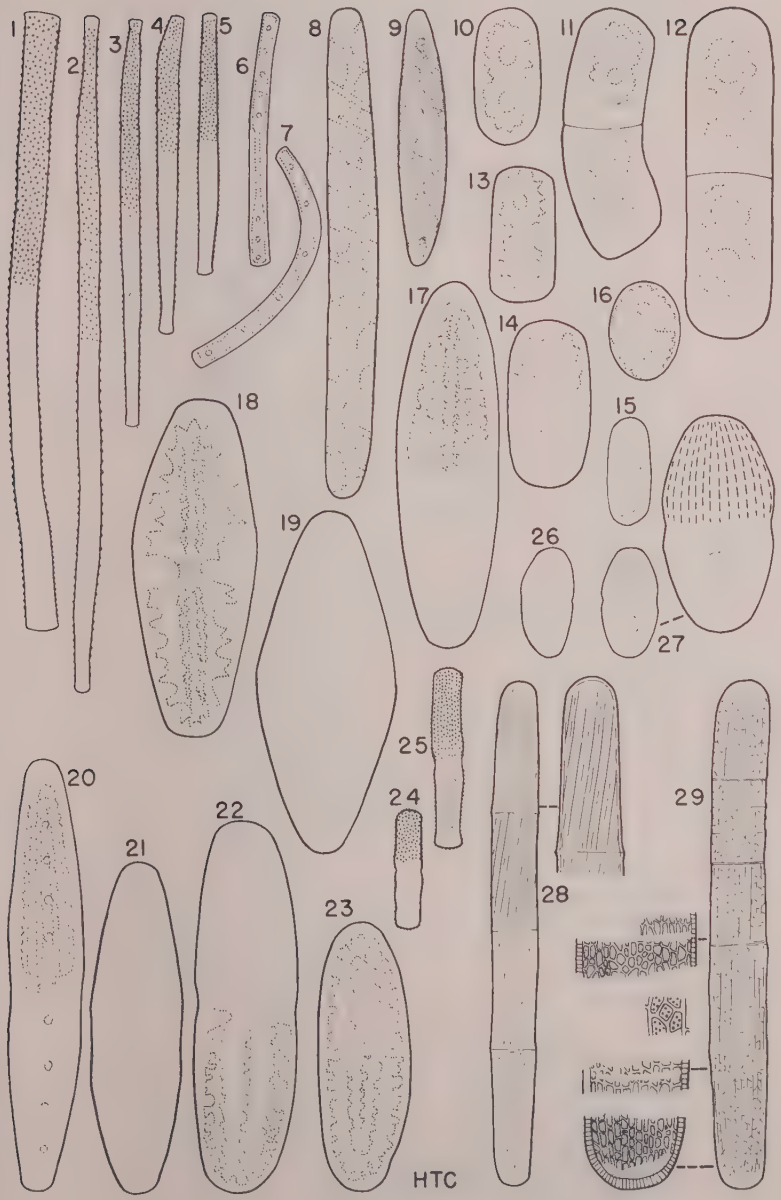

JOHN R.
NOLAN
WISEMAN
67°
BETTLES
ALATNA
KOYUKUK R.
Arctic Circle
UNCONSOLIDATED PLEISTOCENE DEPOSITS
LIMESTONES, CALCAREOUS SANDSTONES, AND ARKOSE...
BIRCH CREEK SCHIST
0 10 20 MILES
0 10 20 30 KILOMETERS
66°
(Modified from MADDREN, 1913)
HTC
152°
151°
150°

PLATE II

PLATE III

1. Gonatozygon monotaenium, × 475
2. G. Brébissonii, × 450
3–5. G. Brébissonii v. tatricum, × 500
6–7. G. Kinahani, × 100
8. Spirotaenia condensata, × 450
9. S. obscura, × 500
10. Cylindrocystis Brébissonii, × 500
11–12. C. Brébissonii f. α, × 500
13. C. Brébissonii f. β, × 375
14. C. Brébissonii v. turgida, × 500
15. C. Brébissonii v. minor, × 475
16. C. crassa v. elliptica, × 500
17. Netrium digitus, × 450
18. N. digitus f. α, × 450
19. N. digitus v. rhomboideum, × 200
20. N. digitus v. lamellosum, × 450
21. N. digitus v. lamellosum f. α, × 325
22. N. oblongum, × 500
23. N. oblongum v. brevius, × 500
24–25. Penium exiguum, × 450
26–27. P. silvae-nigrae f. minor, 26 × 500, 27 × 500, × 1000
28. P. spirostriolatum, × 200, × 325
29. P. spirostriolatum f. α, × 200, × 325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HTC

PLATE III

PLATE IV

1. Closterium libellula v. intermedium, × 375
2–3. C. navicula, 2 × 350, 3 × 375
4. C. cynthia f. α, × 325
5. C. cynthia f. β, × 375, × 750
6. C. cynthia, × 375, × 750
7. C. Archerianum, × 225, × 350
8. C. Archerianum f. α, × 150, × 325
9. C. Baillyanum, × 150
10. C. angustatum, × 225, × 350
11. C. angustatum f. α, × 325, × 650
12. C. angustatum v. gracilius, × 325, × 625
13. C. costatum, × 225, × 350
14. C. striolatum, × 325
15. C. juncidum v. brevior, × 375
16. C. juncidum v. elongatum, × 375

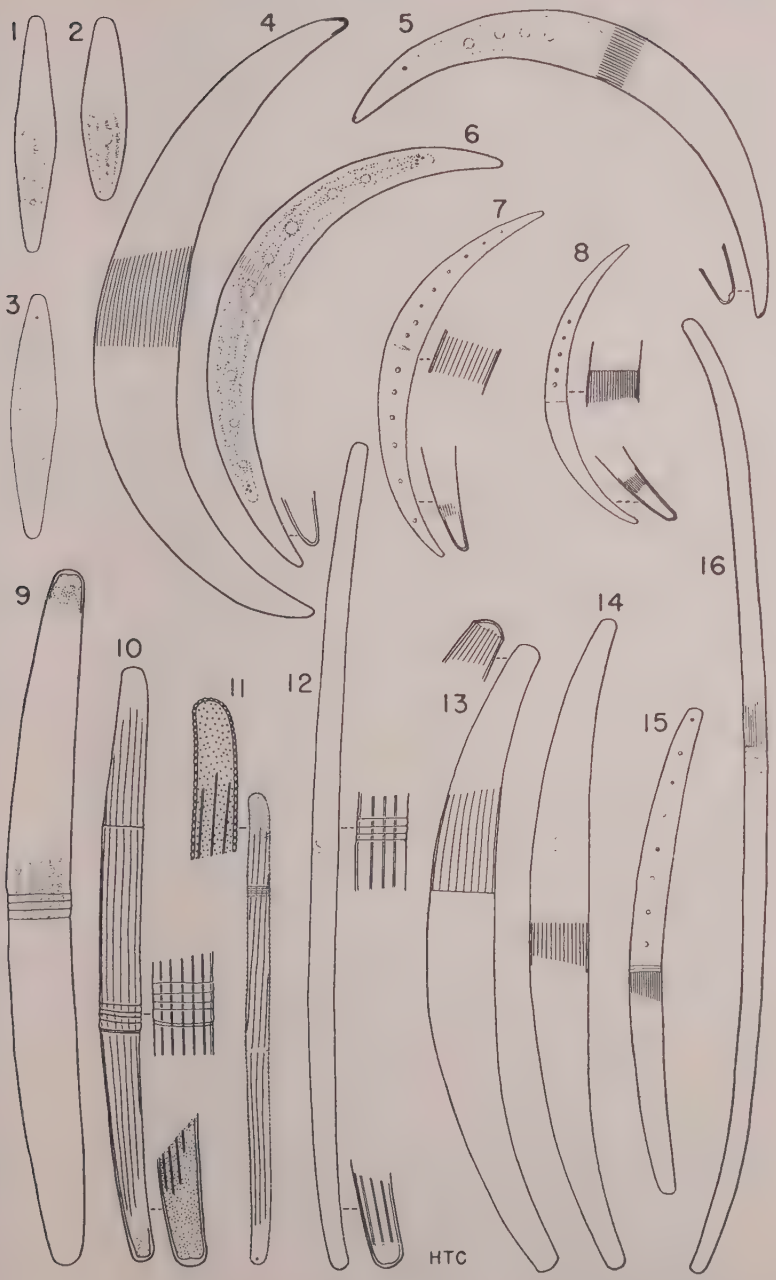

PLATE IV

PLATE V

1–6. Closterium dianae, 1,3,6 × 325, × 650, 2 × 325, × 475, 4,5 × 325, × 500
7. C. dianae v. arcuatum, × 200, × 425
8–9. C. dianae v. minus, × 450, × 900
10. C. dianae v. brevius, × 475, × 950
11–12. C. dianae f. α, 11 × 500, × 1000, 12 × 325, × 650
13–17. C. parvulum, 13–15 × 475, × 950, 16 × 325, × 650, 17 × 450, × 900
18. C. arcuarium, × 450, × 900
19–20. C. tumidulum, × 525, × 1050

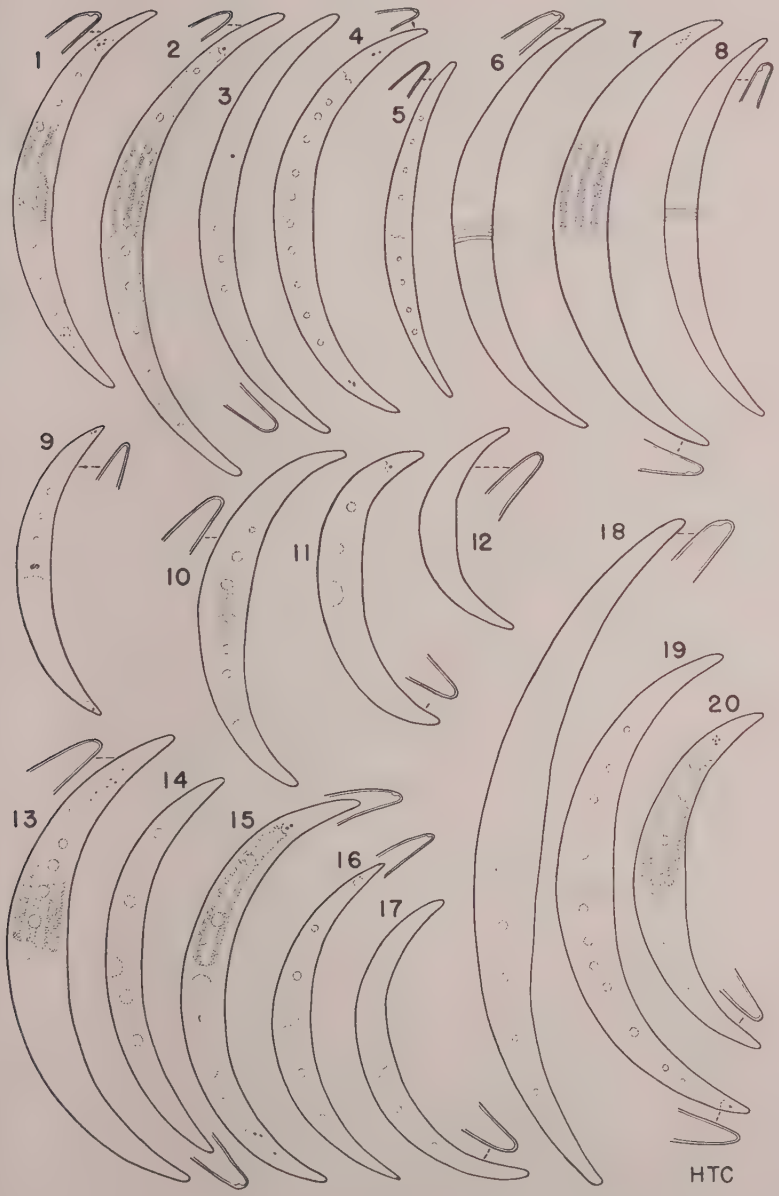

PLATE V

PLATE VI

1. Closterium Jenneri, × 425
2. C. Jenneri f. α, × 425
3–4. C. Jenneri v. tenue, × 475
5–8. C. incurvum, 5,7 × 500, 6 × 450, 8 × 475
9–10. C. incurvum f. α, × 475
11. C. venus, × 475
12–14. C. venus v. crassum, 12,13 × 475, 14 × 450
15–16. C. venus v. maior, 15 × 475, 16 × 325
17. C. venus f. α, × 475
18. C. cuspidatum, × 450
19. C. Leibleinii v. minimum, × 475
20. C. Ehrenbergii, × 100
21. C. moniliferum, × 325
22. C. moniliferum v. concavum, × 325

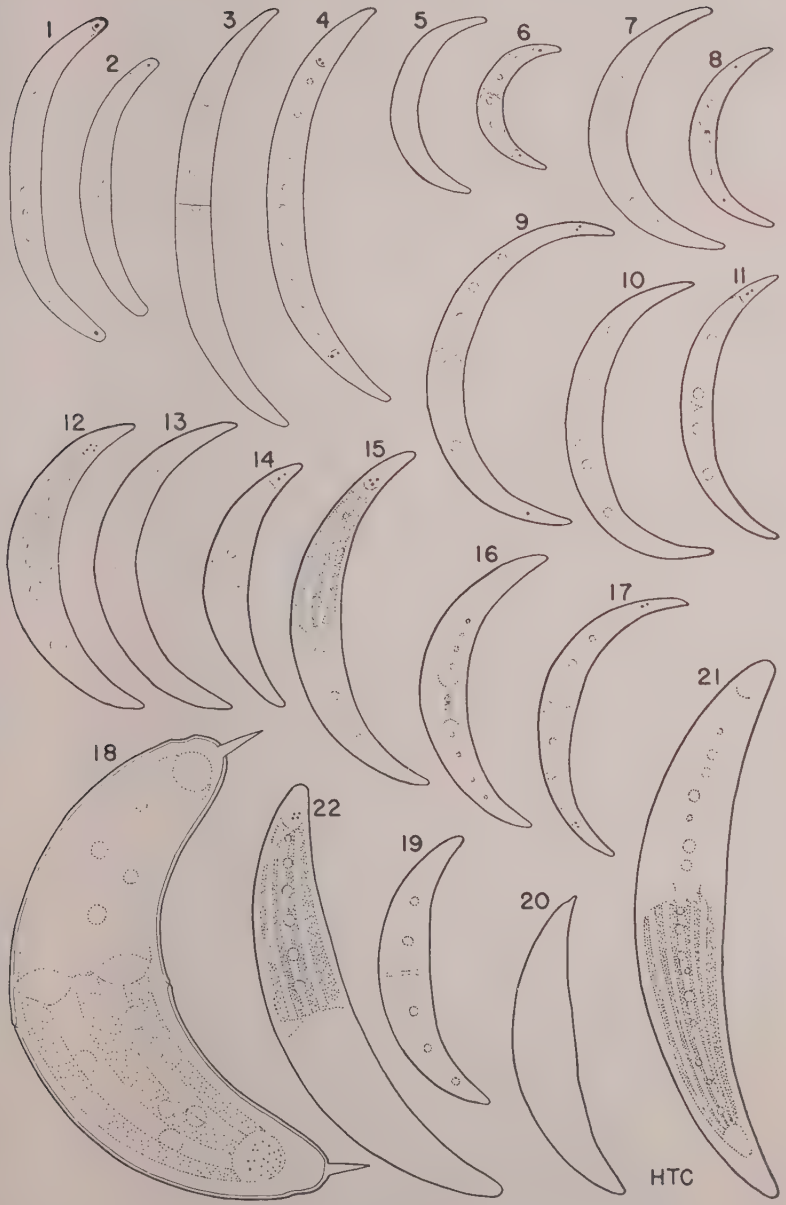

PLATE VI

PLATE VII

1. Closterium acerosum, × 200
2. C. acerosum f. α, × 325
3. C. acerosum v. minus, × 475
4. C. lunula, × 100
5. C. lunula f. gracilis, × 100
6. C. pseudolunula, × 325
7. C. Pritchardianum f. laeve, × 325
8. C. Pritchardianum, × 325
9. C. praelongum, × 325, × 500
10. C. tumidum f. α, × 450

11–12. C. tumidum, × 325

13. C. cornu, × 425

14–15. C. cornu f. α, × 475

16. C. praelongum v. brevius, × 325, × 475

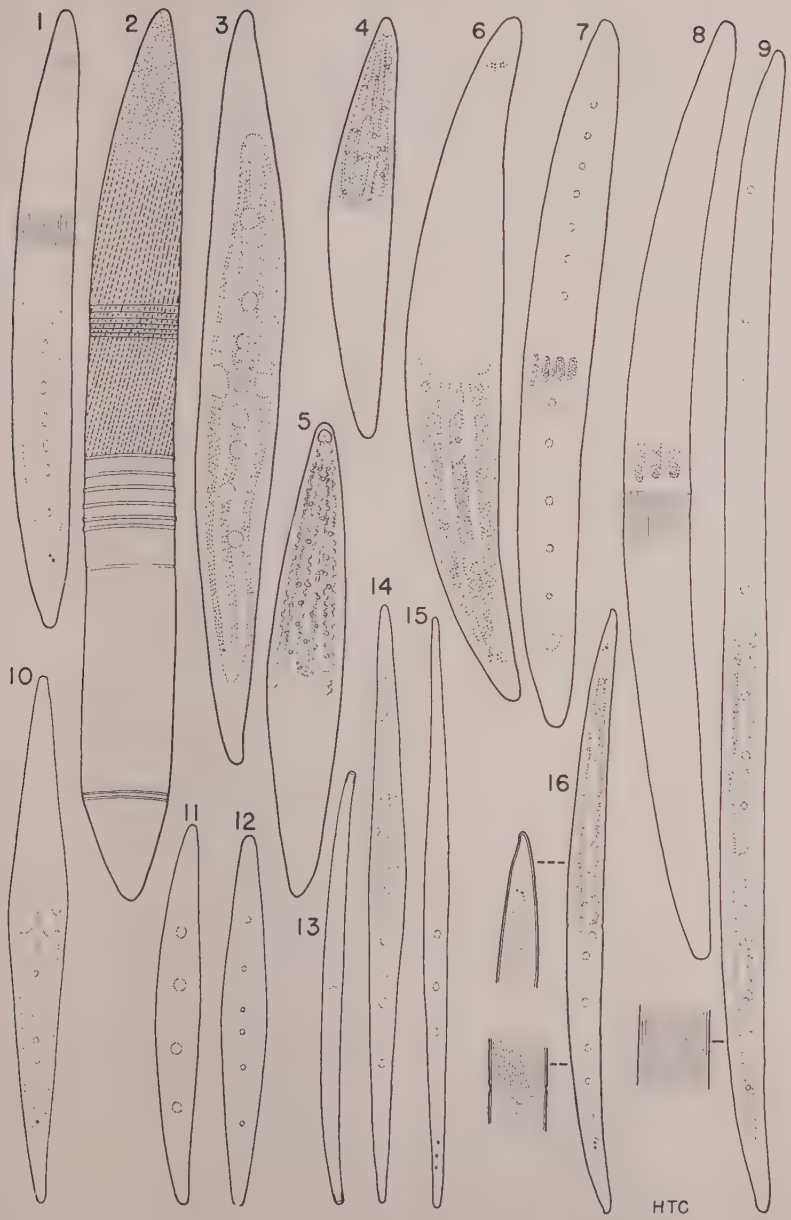

PLATE VII

PLATE VIII

1–2. Closterium toxon, × 375
3. C. strigosum v. elegans, × 525
4. C. gracile, × 525
5. C. gracile f. sigmoideum, × 525
6. C. gracile, × 525
7. C. gracile v. tenue, × 525
8. C. pronum, × 375
9. C. idiosporum (?), × 375
10. C. Ralfsii v. hybridum, × 250, × 550
11. C. lineatum v. elongatum, × 125, × 600
12. C. lineatum, × 100, × 600
13. C. acutum, × 600

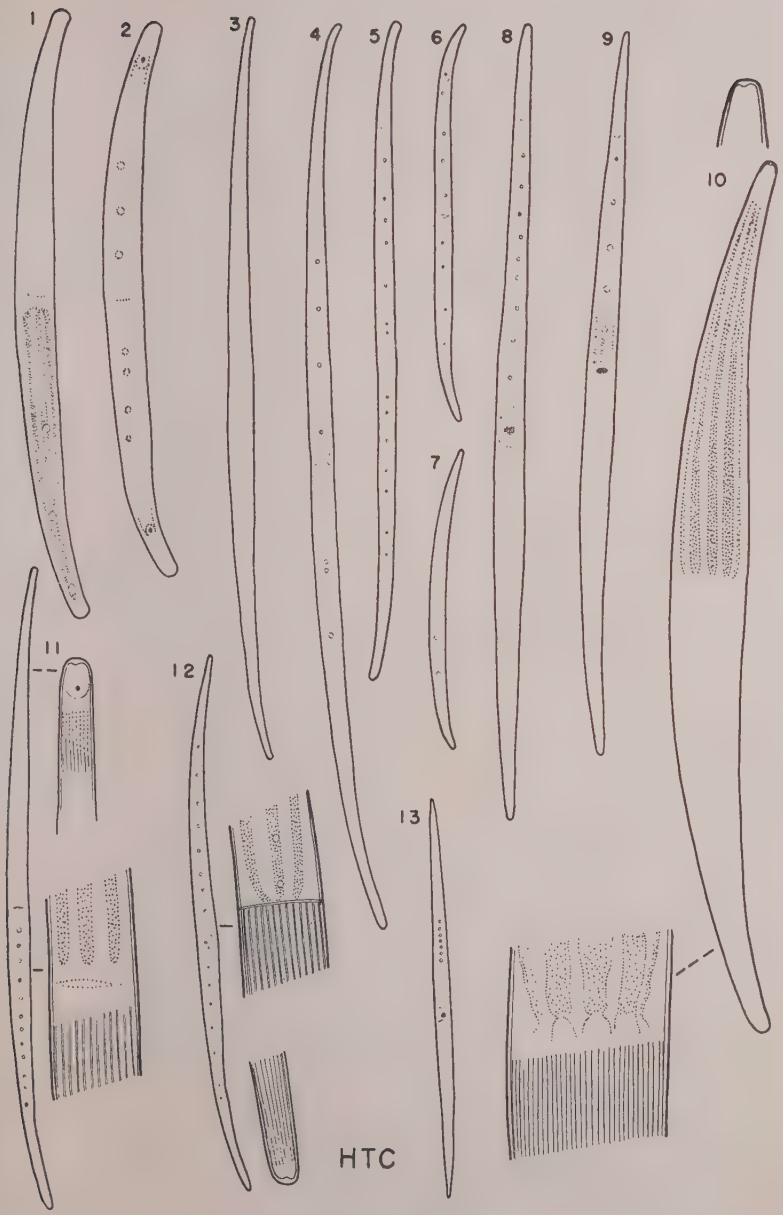

PLATE VIII

PLATE IX

1. Closterium Kuetzingii, × 250, × 550
2. C. Kuetzingii v. laeve, × 250
3. C. Kuetzingii v. laeve f. *a*, × 250
4–5. C. rostratum, 4 × 375, 5 × 250, × 375
6. C. setaceum, × 375, detail from larger plant × 425
7. Pleurotaenium eugeneum, × 125, × 375
8. P. truncatum, × 375, × 550
9–10. P. truncatum v. crassum, × 375

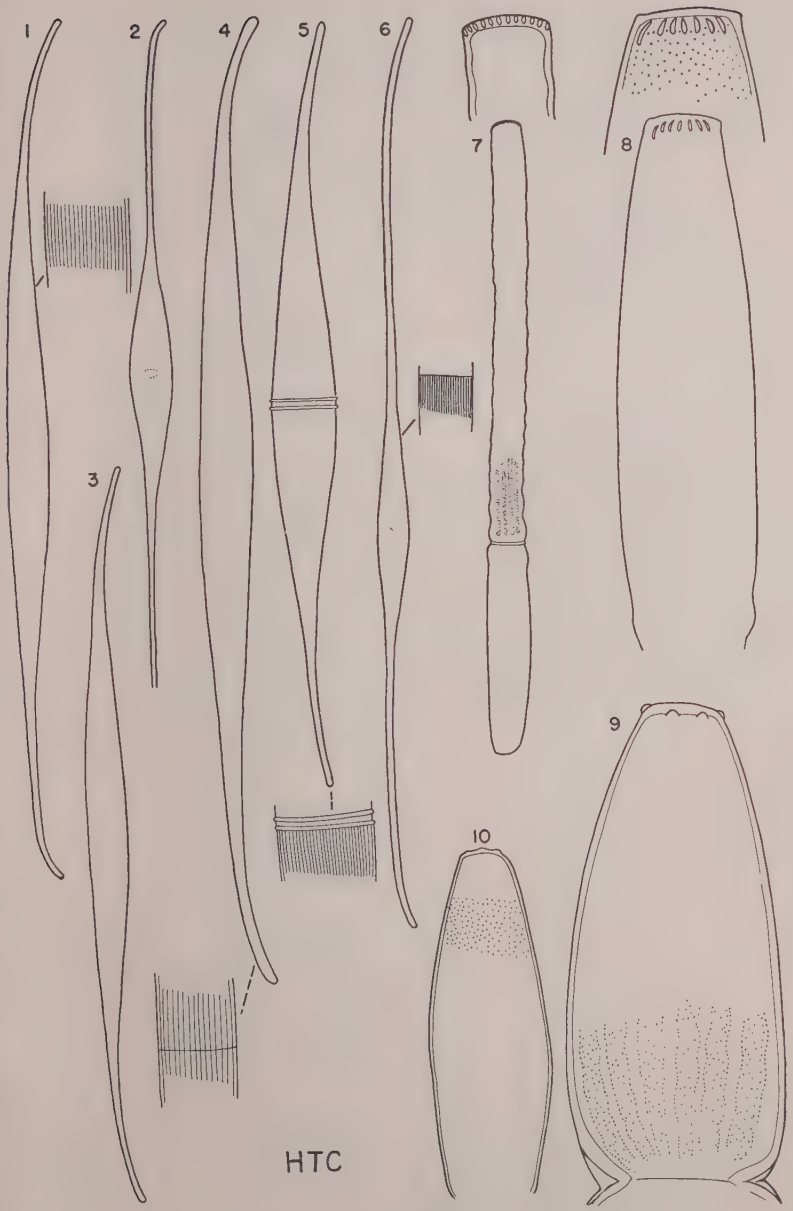

PLATE IX

PLATE X

1. Pleurotaenium Ehrenbergii, × 325, × 475
2. P. Ehrenbergii f. *a*, × 475
3. P. Ehrenbergii v. curtum, × 325, × 475
4. P. Ehrenbergii v. elongatum, × 325, × 475
5. P. trabecula, × 375
6. P. trabecula v. crassum, × 325
7. P. trabecula v. elongatum f. scrobiculatum, × 325, × 475
8. P. trabecula v. hirsutum, × 325
9. P. trabecula v. rectum, × 450
10. P. minutum, × 325
11. P. minutum v. elongatum, × 450
12. P. minutum v. gracile, × 450
13. Tetmemorus laevis, × 500

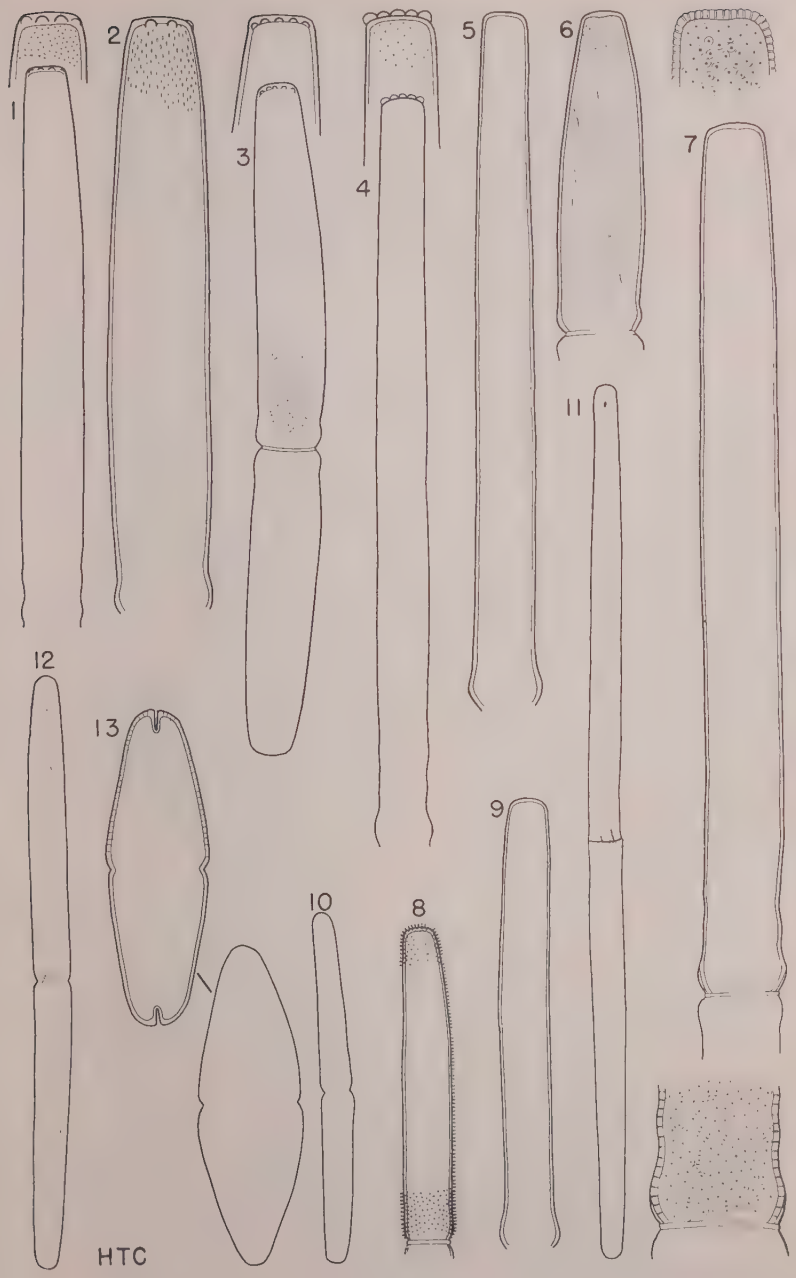

PLATE X

PLATE XI

1. Euastrum oblongum, × 450
2. E. oblongum f. *α*, × 450
3. E. sinuosum v. scrobiculatum, × 450
4. E. ansatum, × 500
5. E. ansatum f. *α*, × 450
6. E. ansatum v. dideltiforme, × 450
7. E. obesum v. crassum, × 450
8. E. pectinatum v. brachylobum, × 450
9. E. pectinatum v. rostratum, × 500
10. E. tetralobum, × 500
11. E. verrucosum, × 475

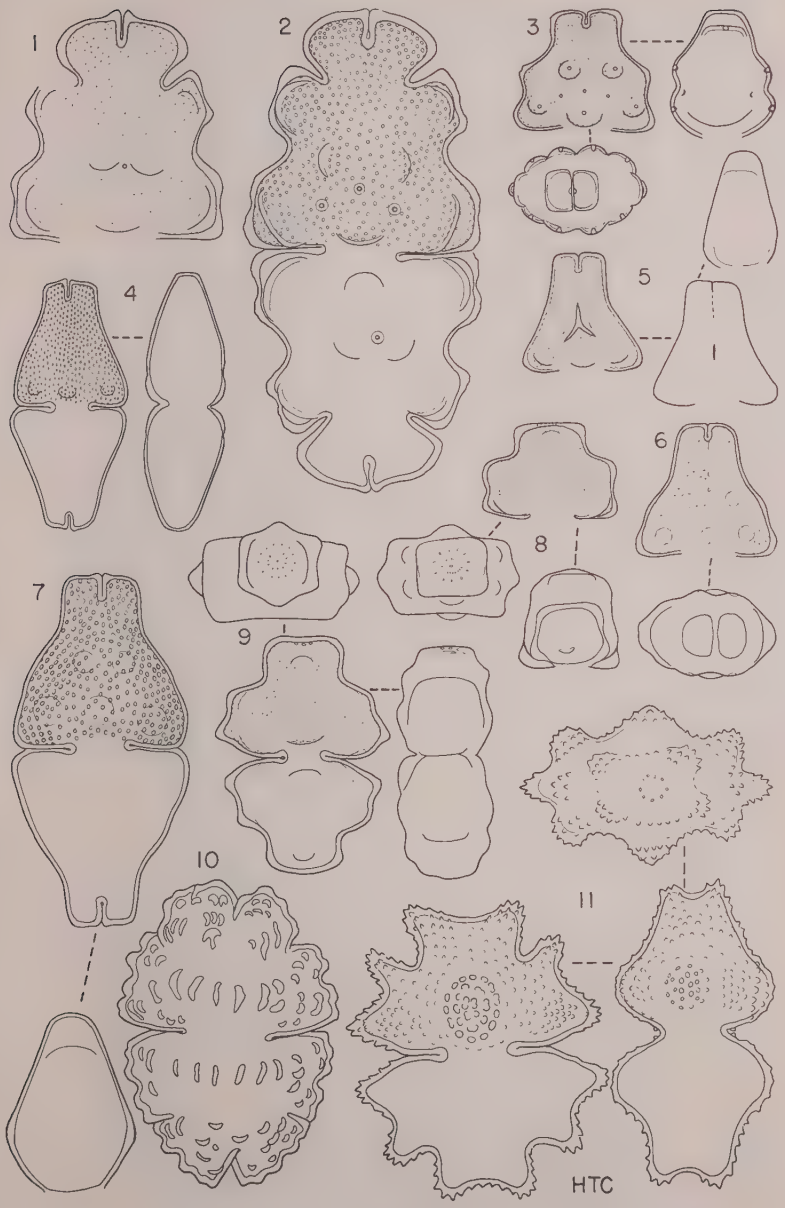

PLATE XI

PLATE XII

1–2. Euastrum Turneri, 1 × 675, 2 × 750
3. E. evolutum v. integrius, × 700
4. E. lapponicum, × 675
5. E. lapponicum f. α, × 700
6. E. dubium f. α, × 750
7. E. dubium f. β, × 700
8. E. dubium v. ornatum, × 750
9–10. E. dubium v. ornatum f. α, × 750
11. E. dubium v. poriferum, × 750
12–13. E. bidentatum, 12 × 800, 13 × 750
14. E. bidentatum f. α, × 750
15. E. bidentatum v. oculatum f. α, × 750

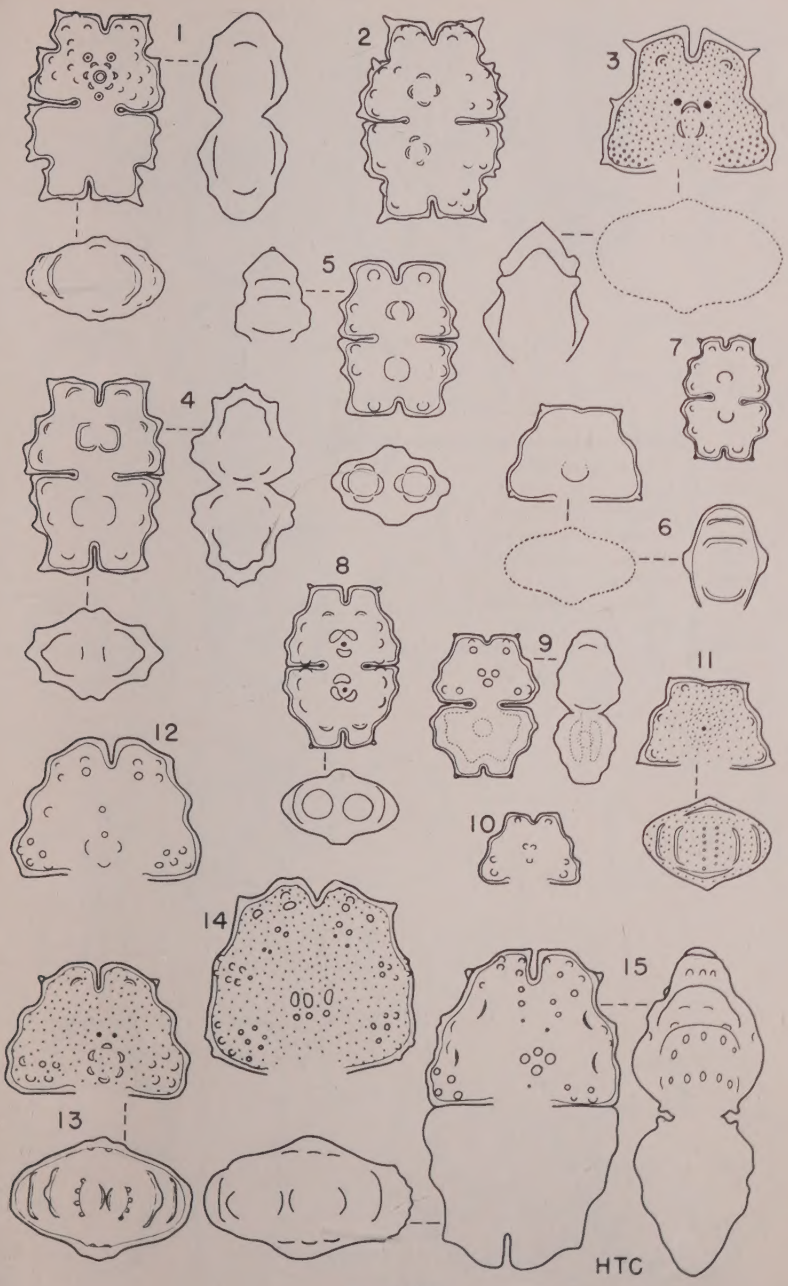

PLATE XII

PLATE XIII

1. Euastrum erosum v. granulosum, × 800
2–4. E. Ciastonii, × 700
5–6. E. elegans, 5 × 750, 6 × 700
7. E. binale v. Grönbladii, × 700
8–9. E. binale v. Gutwinskii, × 750
10. E. binale v. tumoriferum, × 800
11–12. E. denticulatum, 11 × 750, 12 × 700
13. E. insulare v. silesiacum, × 750
14. E. crassicolle, × 800
15. E. crassicolle v. dentiferum, × 1375
16. E. validum, × 700
17. E. sp., × 800
18. E. sp., × 500

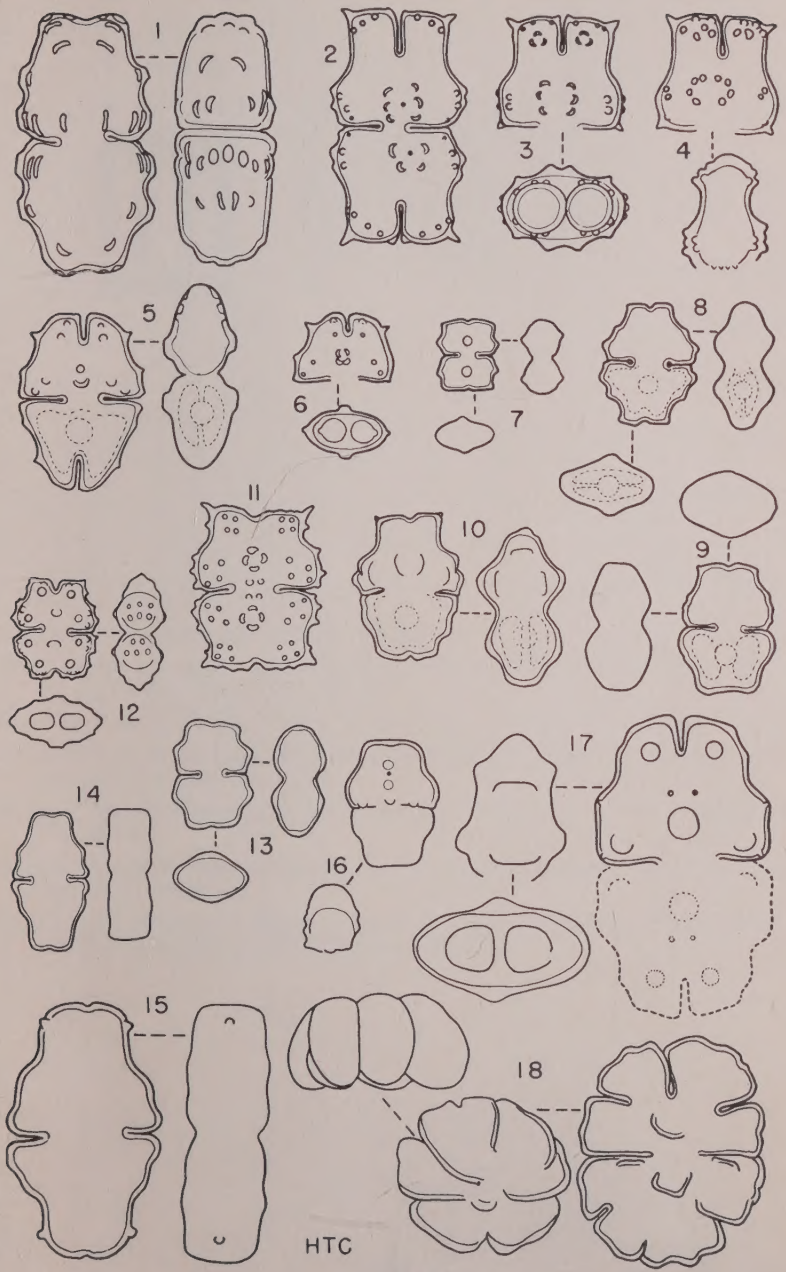

PLATE XIII